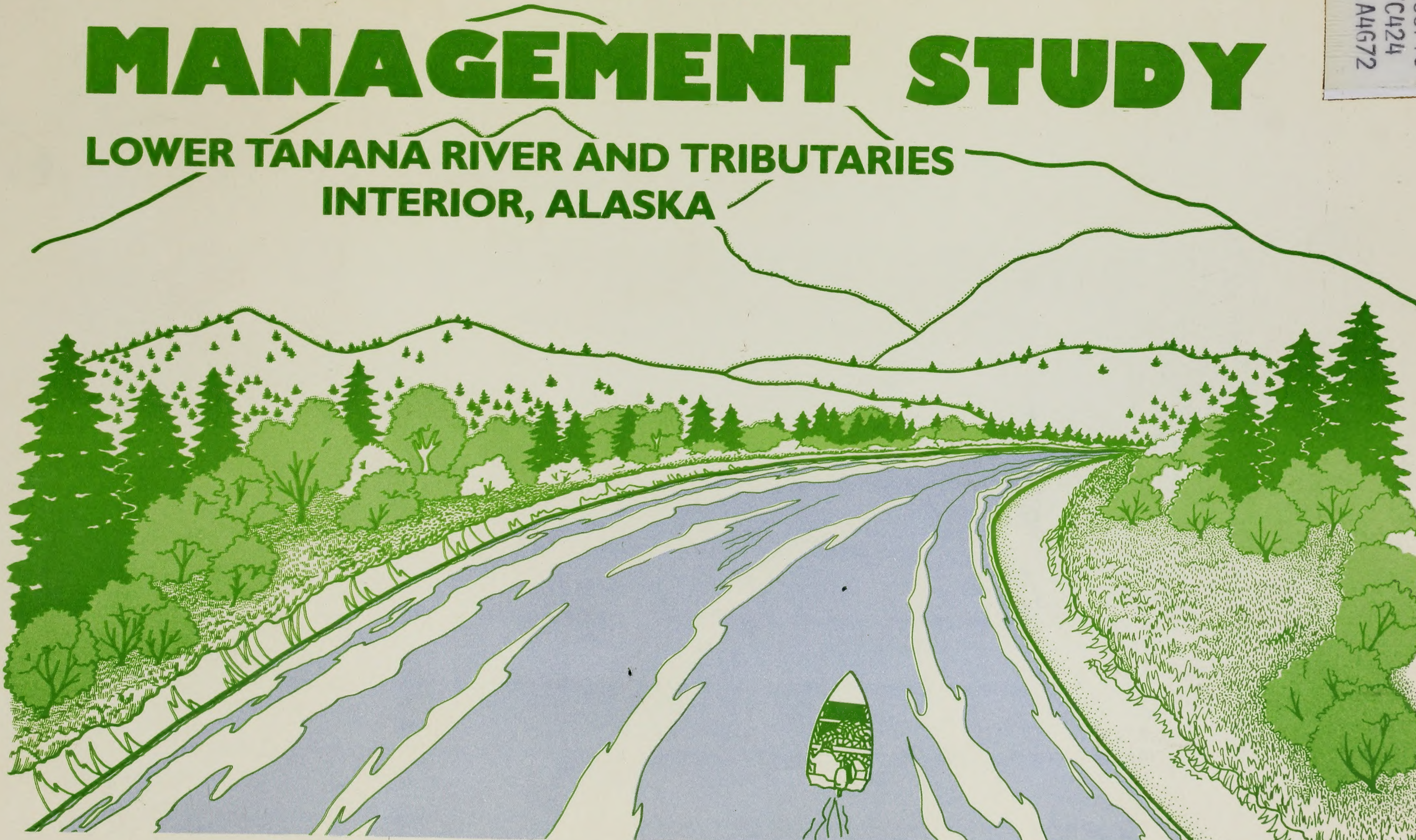
FLOOD PLAIN MANAGEMENT STUDY

LOWER TANANA RIVER AND TRIBUTARIES
INTERIOR, ALASKA



MAY, 1983

PREPARED BY THE
U.S. DEPARTMENT OF
AGRICULTURE
SOIL CONSERVATION SERVICE

IN COOPERATION WITH THE
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL AND
GEOPHYSICAL SURVEY

FLOOD PLAIN MANAGEMENT STUDY

(LOW INTENSITY)

LOWER TANANA RIVER AND TRIBUTARIES INTERIOR, ALASKA

Prepared by the
U.S. DEPARTMENT OF AGRICULTURE
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STATE OF ALASKA
Department of Natural Resources
Division of Geological and Geophysical Survey

Edward Grey, Hydraulic Eng. S.C.S.
Devony Lehner, Biologist S.C.S.

Graphics by
Robin Hall, artist DNR
Patricia Kerschner, DNR

FOREWORD

The flood hazard information in this report will provide local government and planning groups with a basis for formulating flood plain land-use and management programs, adopting regulations, and informing the public of flood hazards and of options for controlling flood damages along the Lower Tanana River and tributary rivers and streams. The villages of Tanana, Manley Hot Springs, Minto, Eureka, Tofty, Livengood, Cantwell, Windy, Healy, and Nenana are within the study area. Streams considered in the study are the Chatanika, Tatalina, Tolovana, and West Fork Rivers, and Little Goldstream, Goldstream, Washington, Globe, O'Brien, Livengood, Lost, Hutlinana, Baker, Blowback, and Tatlanika Creeks draining from the north; and Chitinana, Cosna, Zitziana, Kantishna, Toklat, Bearpaw, McKinley, Foraker, Herron, Teklanika, Nenana, Totatlanika and Wood Rivers draining from the south.

There will be a low intensity flood plain management study forthcoming covering the Upper Tanana River, and a study covering the middle portion of the river, as set forth in the plan of work. For more detail see Figure 1A.

The Soil Conservation Service implemented the technical phases of the study. The State of Alaska and Alaska Soil and Water Conservation District assisted in providing land use data and obtaining permission for field surveys, and made available materials to be used for the study. The State Department of Natural Resources through the Division of Geological and Geophysical Survey provided one-half of the cost of developing the report. The Department will also distribute the report and help users interpret study data, ensuring that data can be used effectively in local flood plain management programs. The State of Alaska and the Soil Conservation Service encourage the immediate use of the flood hazard information in implementing local programs, and upon request will assist in interpretation and use of data presented in the report.

The cooperation and assistance of other federal, state, and local agencies and property owners in the collection of data for this report are greatly appreciated.

TABLE OF CONTENTS

INTRODUCTION

Local Study Needs

The Alaska Department of Community and Regional Affairs, Division of Community Planning, requested the Soil Conservation Service, through the Alaska Soil and Water Conservation District and Alaska Department of Natural Resources, to carry out flood studies of the Tanana River. State land disposals, location of new facilities, land use planning and classification, and plans for expansion of some villages in the study area create a need to define the 100-year flood boundaries along local streams and rivers to insure that flood plain lands will be properly managed. This report defines the areas subject to flooding so that adequate flood plain management programs can be implemented to regulate land use and development in flood prone areas. Such management programs will reduce potential flood damage, assure wise land use, and maintain and enhance the riverine environment in the vicinity of affected communities.

Study Authorities

In accordance with the November 1982 Cooperative Agreement, amended September 1983, between the Alaska Department of Natural Resources, Division of Geological and Geophysical Survey (Department) and the Soil Conservation Service (SCS), the Department established priorities among study areas and designated this study to be carried out by the SCS. The September 1982 Plan of Work outlined the specifics of the study.

Authority for SCS participation in flood plain management studies is provided by Section 6 of Public Law 83-566 (Watershed Protection and Flood Prevention Act of 1954). The SCS carries out such studies in accordance with Executive Order 11988 dated May 24, 1977 and recommendation 9(c) of House Document No. 465, 89th Congress. The authority for State cooperation in the study is stated in A.O. 46 of Alaska State Laws.

This report covers portions of the Tanana River, as well as all or part of the tributaries listed in the foreword. Other flood related studies in the vicinity are the Chena Flood Control Project at Fairbanks; the Flood Insurance Study at Delta Junction by the U.S. Corps of Engineers; and the Delta Flood Hazard Study, of low intensity, developed by the Soil Conservation Service.

DESCRIPTION OF THE STUDY AREA

This flood plain management report concerns the rivers and streams, mentioned above, in hydrologic unit 19030004 and is bounded by the Alaska Mountain Range and Kuskokwim Mountains to the south, the Fairbanks-Northstar Borough boundary line to the east, the drainage divide between the Tanana and Yukon Rivers to the north, and to the west an arbitrary cutoff about one mile downstream of the Yukon-Tanana Rivers confluence.

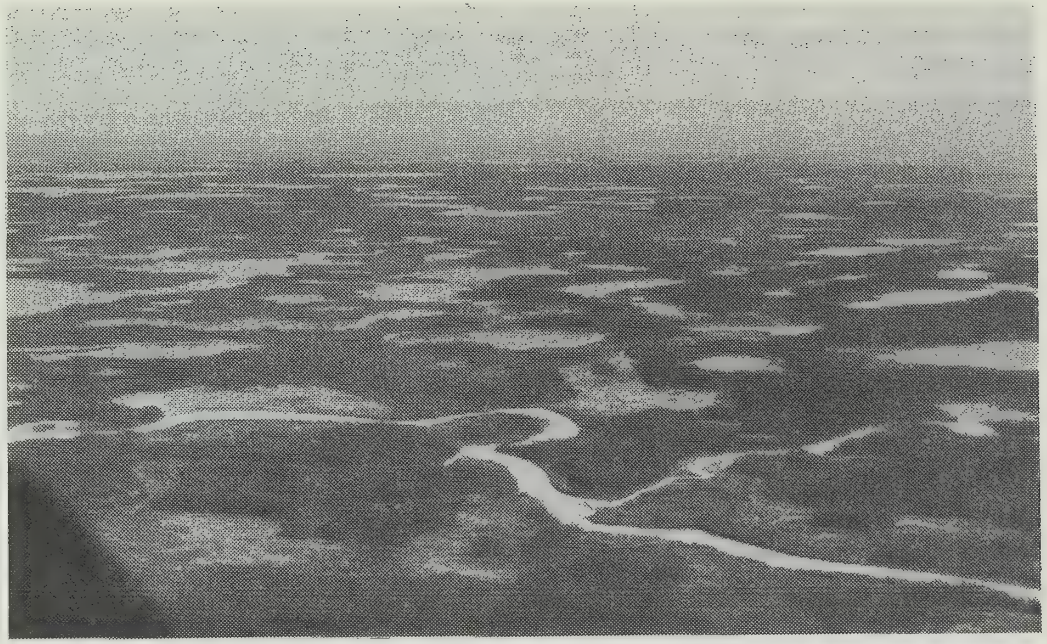
Elevations in the study area range from about 300 feet above mean sea level to about 20,320 feet above mean sea level at the top of Mt. McKinley in the Alaska Mountain Range. The area generally slopes to the south and north. All of the streams in the study area drain into the Tanana River. The Tanana River drains into the Yukon River which drains to the west into the Bering Sea.

Source: SCS

The upper portions of the Nenana River with snow covered Alaska Range in background.

Areas adjacent to the streams are nearly level to undulating. Low hills with irregular slopes are prominent, and bogs and other wetlands are common.

Below timberline (about 2,500 feet above mean sea level elevation) on the better drained soils and flood plains, paper birch-white spruce stands are the predominant vegetation. Shrub and other non-forest vegetation types are predominant on poorly drained soils, and are often associated with the numerous sphagnum bogs. Alder, cottonwood, and willow are common in flood plains adjacent to streams and rivers. Vegetation above timberline, 2,500 feet and higher, is predominately tundra underlain by permafrost. At elevations above 5,000 feet, much of the area is covered with snow and ice.



Source: SCS

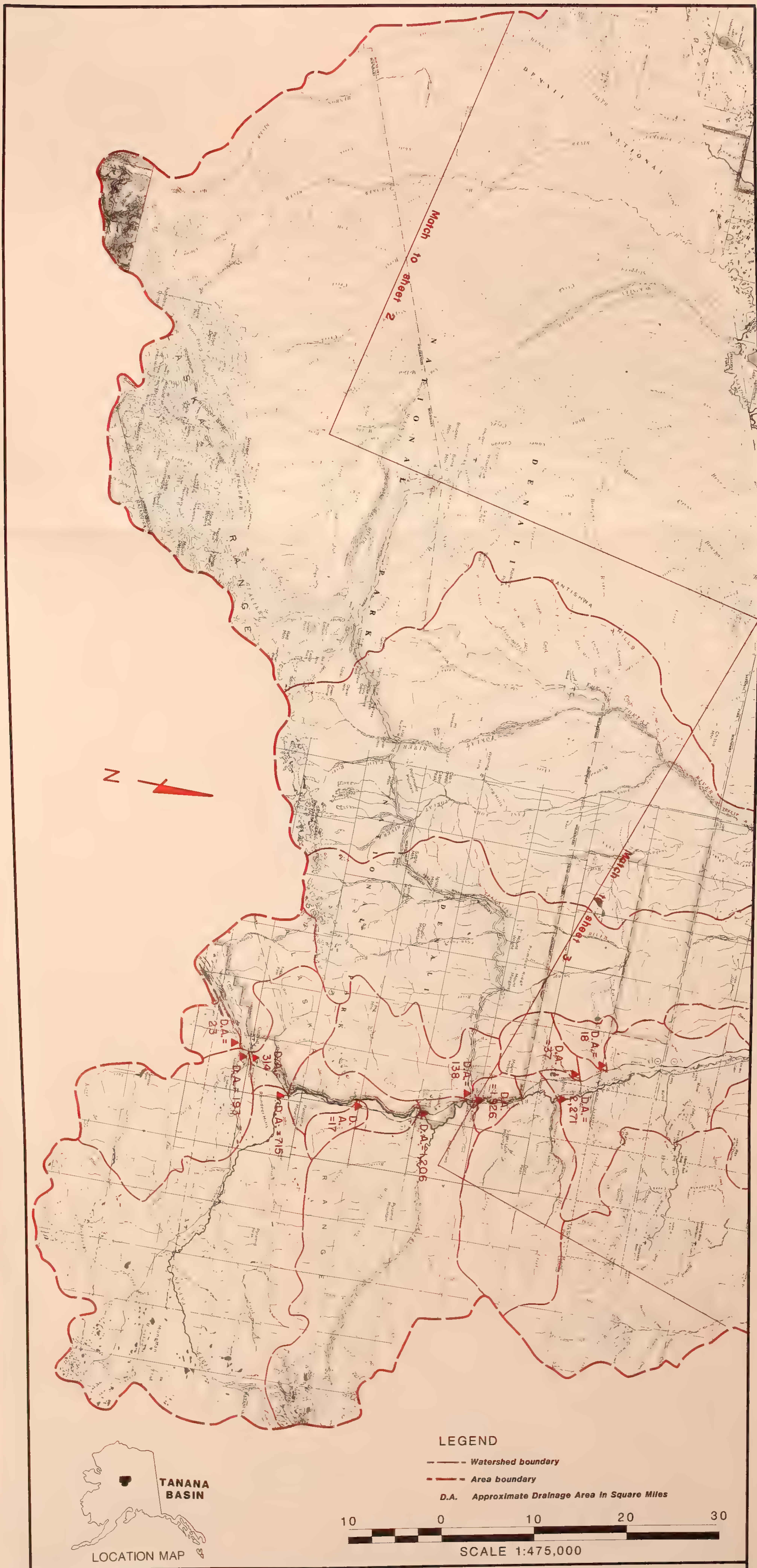
Typical lowland vegetative cover is black spruce, sedges, and grass in the wet areas, with many lakes and bogs. (July 12, 1983)

Source: SCS

Some of the area is covered with a thick growth of timber (birch and white spruce) with intermittent areas of grassy land and low brush. (July 12, 1983)

Source: SCS

Sphagnum bogs, lakes, and other wetlands are common on both lowlands and uplands.



LEGEND

Watershed boundary

Area boundary

D.A. Approximate Drainage Area in Square Miles

10 0 10 20 30

SCALE 1:475,000

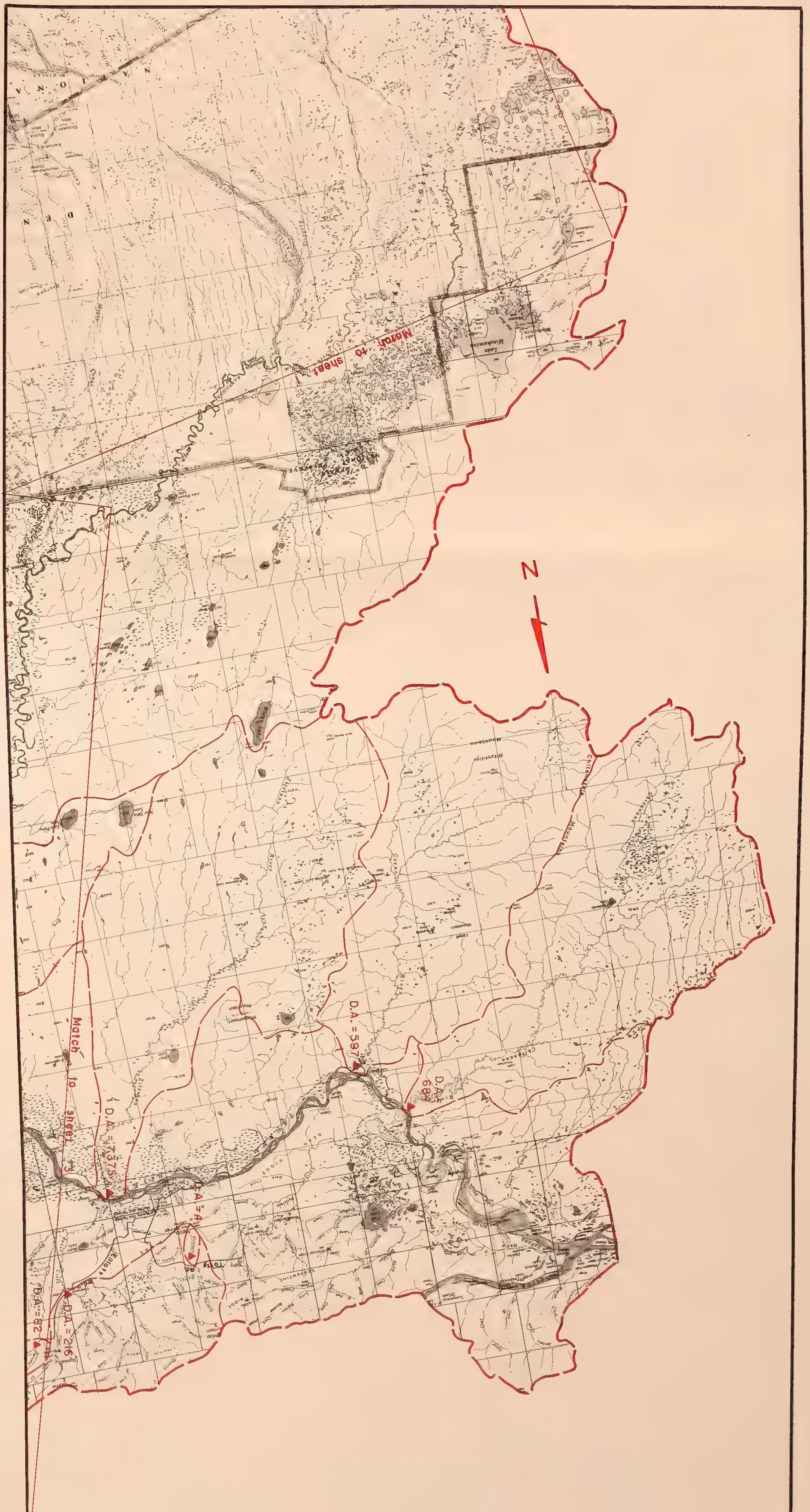
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

VICINITY MAP

LOWER TANANA RIVER BASIN

Sheet 1 of 3

FIGURE 1



LEGEND

Watershed boundary

Area boundary

D.A. Approximate Drainage Area in Square Miles

10 0 10 20 30

SCALE 1:475,000

LOCATION MAP

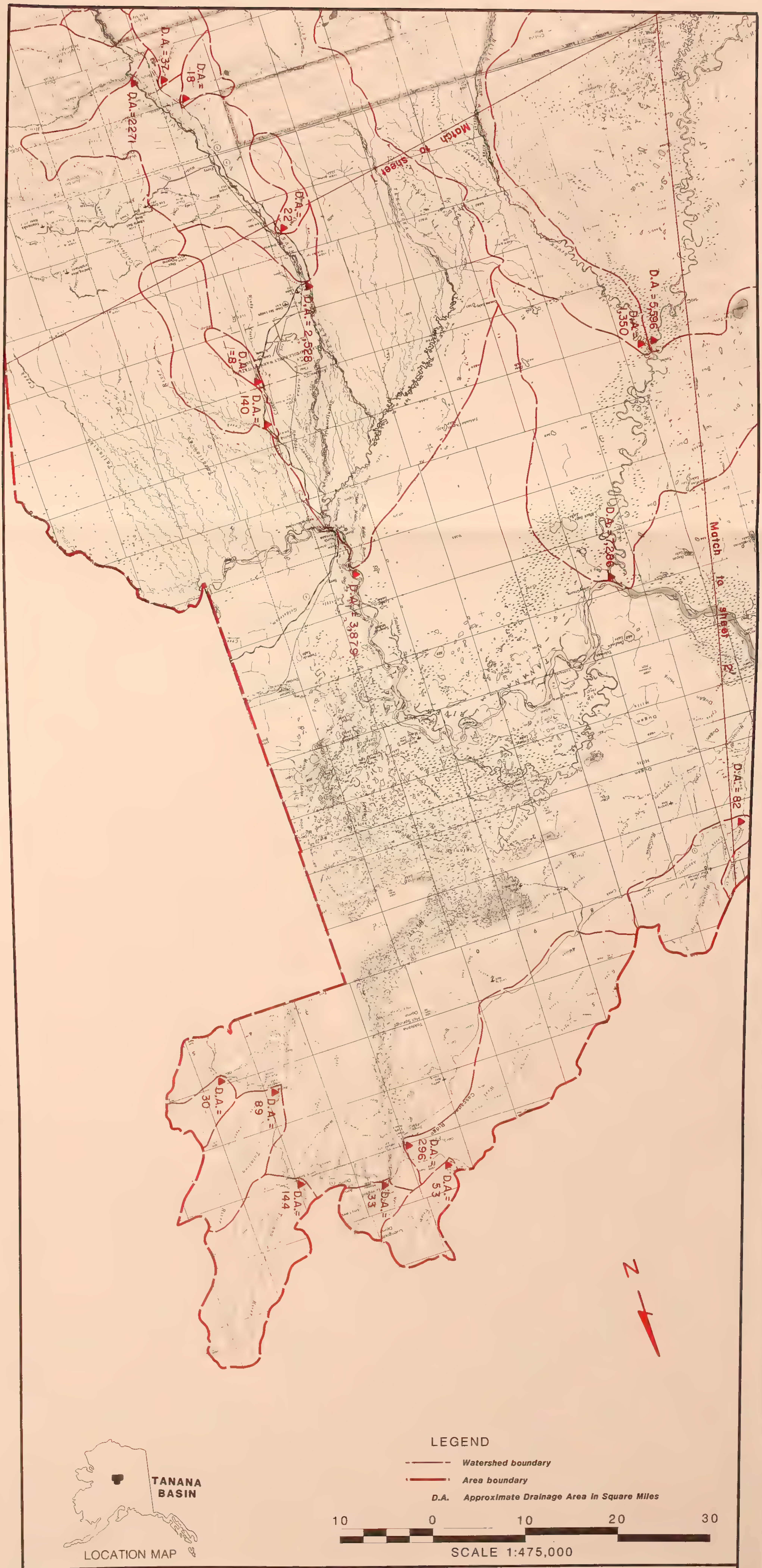
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

VICINITY MAP

LOWER TANANA RIVER BASIN

Sheet 2 of 3

FIGURE 1



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

VICINITY MAP
LOWER TANANA RIVER BASIN

Sheet 3 of 3

FIGURE 1

STATE OF ALASKA

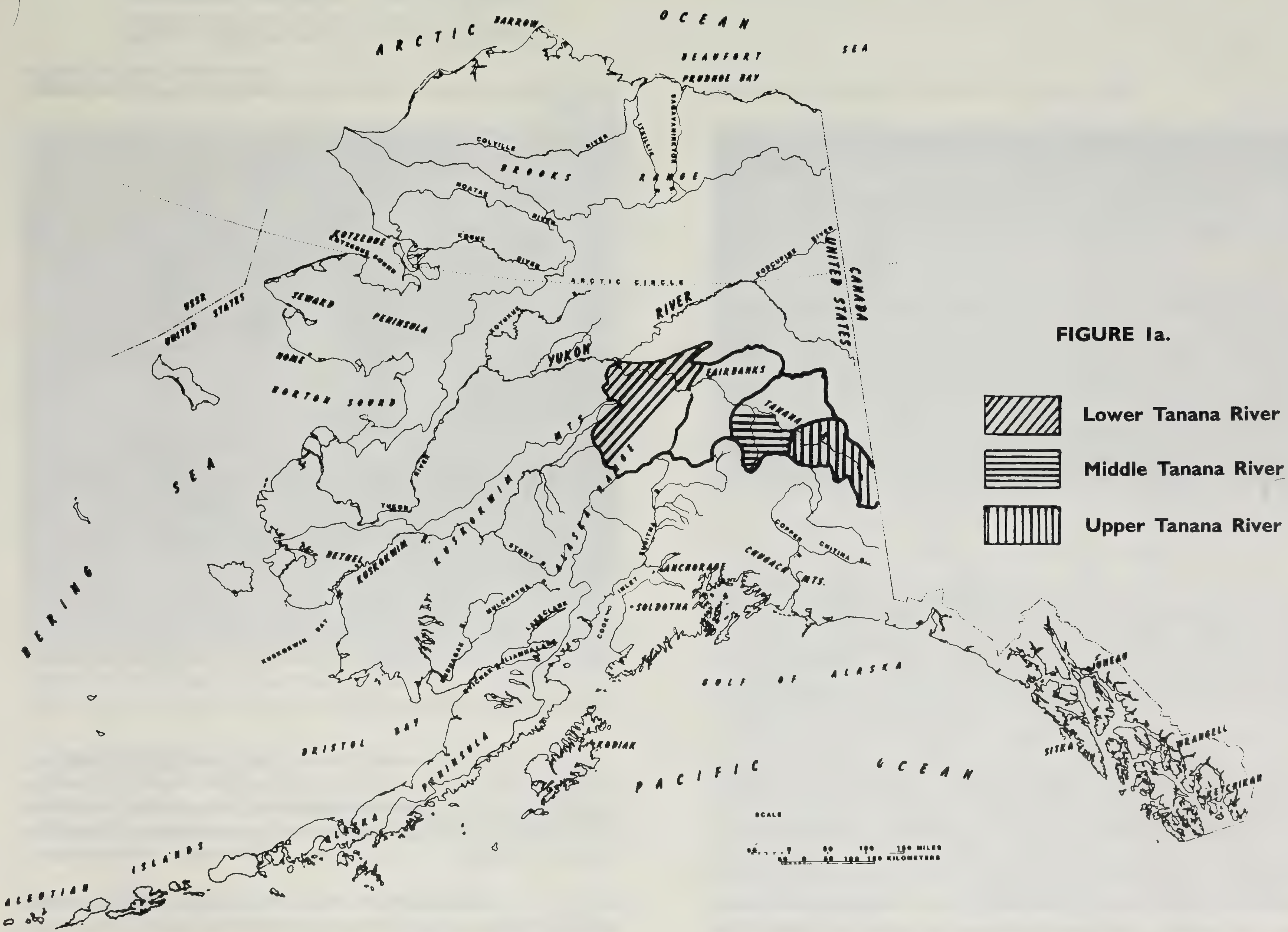


FIGURE Ia.

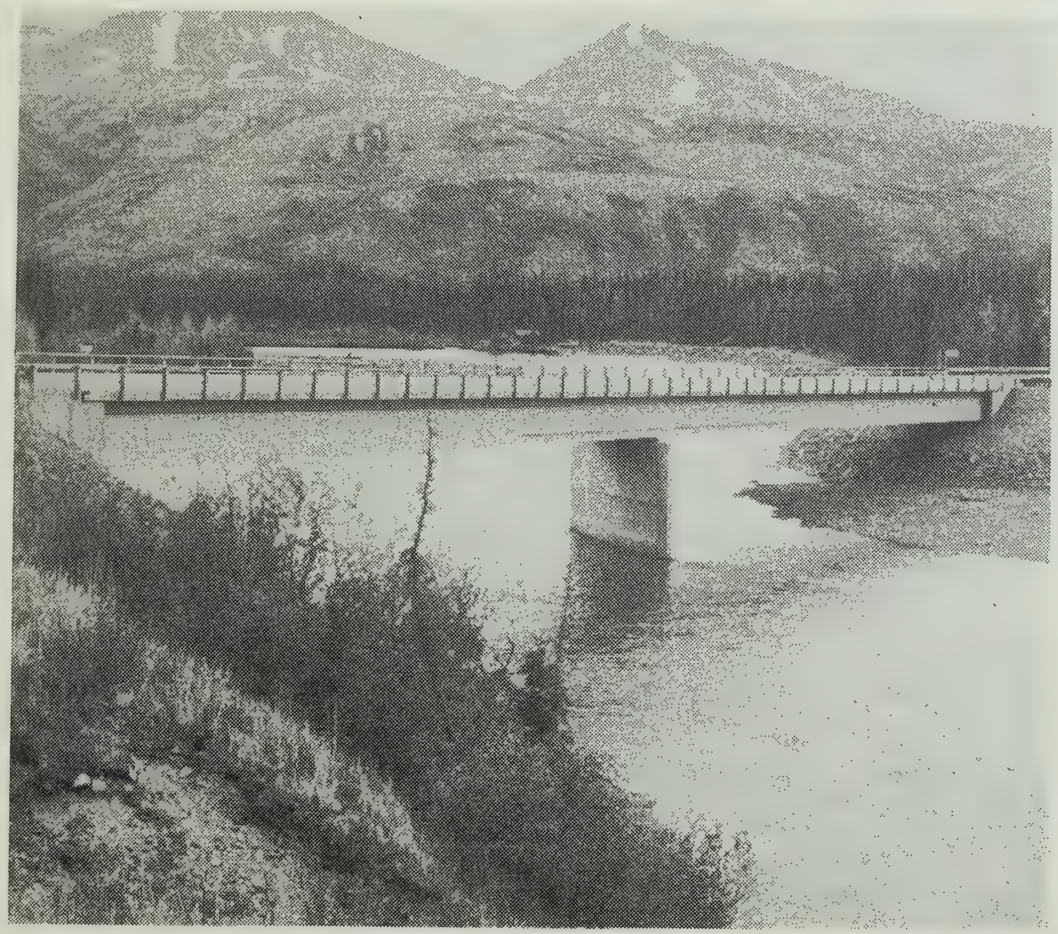
Lower Tanana River

Middle Tanana River

Upper Tanana River

Stream channel slopes range from less than one foot per mile in the lower reaches to about 3000 feet per mile in the mountains.

Access to most of the area is by air or water in summer. In winter, airplanes on skis, snowmobiles, and dog sleds are used to travel into and throughout the area. The Elliot Highway connects with the Steese and Trans-Alaska Pipeline Road into Manley Hot Springs, Minto, and Livengood. The Elliot Highway crosses many of the streams via bridges and culverts.



Source: SCS

Vegetative cover in foothill areas consists primarily of tundra types. Many of the streams bordered by shrubs have beaver dams on them.

Area climate is influenced by continental conditions. Temperatures range from minus 60 degrees to plus 100 degrees F. The average daily maximum temperature in the summer is in the upper 70's, with middle 40's being common. Mean minimum January temperature is -20 degrees F. Temperatures of 32 degrees F or lower have been recorded during every month of the year. Average maximum winter temperatures are about 0 degrees F. Precipitation ranges from about 15 inches in the lowlands to about 80 inches at higher elevations. Average snow depth is about 60 inches in the lowlands and 400 inches in the mountains. Streams and lakes generally freeze to a depth of several feet every winter. During spring breakup, snow and ice recede to the higher elevations until most is melted; however some mountainous areas remain covered with ice and snow year-round. Glaciers exist in parts of the Alaska Range within the study area. Surface water is plentiful but is often of low quality due to high concentrations of suspended glacier silt.

Source: SCS

Snow and ice are common in the foothills of the Alaska Range.

NATURAL VALUES OF FLOOD PLAINS

General

In flood plains, both the processes shaping life on land and those affecting life in water overlap. The result is a combination of conditions unique in nature. More specifically, conditions in riverine flood plains tend to produce: fertile soils, productive and diverse plant and animal communities, relatively stable and mild microclimates, level to gently undulating topography, and plentiful high-quality water supplies. As a result, such flood plains provide abundant, varied, and often unique biological resources and cultural opportunities. In addition, flood plains generally moderate flood severity and protect water quality and quantity. Other areas where land and water meet provide some of the same benefits and perform some of the same functions; however, two features make riverine flood plains and adjoining riparian habitats unique: 1) the waters that create these flood plains are flowing waters; hence they can carry organic nutrients, inorganic solids, and living organisms great distances and deposit them far from their origins; and 2) riverine flood plains, and the rivers they border, form long usually linear networks that interconnect watershed environments such as glacial moraines, alpine tundras, timberline shrublands, lowland swamps and forests, and estuarine tidelands. As a result, they are commonly used as travel corridors by fish and wildlife and by humans moving among these environments.

The numerous values of flood plains are well documented. Below, biological and cultural values of riverine flood plains are reviewed briefly, with particular reference made to flood plain conditions typical along the Tanana River and other rivers and streams in the Flood Plain Management Area.

I. Biological Values:

1. Flood plains and other riparian habitats generally support a greater variety of wildlife than surrounding upland areas:

As is well known, each organism lives in those environments to which it is adapted, that is, those habitats that provide appropriate kinds of food, shelter, water, and living space. The greater the variety of food and cover an area provides, the more kinds of organisms are generally able to live there. This is one key to the large variety of wildlife species commonly found in flood plains: these areas are characterized by two kinds of habitat variety, both 1) variety **among** different habitat types, and 2) variety **within** individual habitat types.

Variety **among** flood plain habitats tends to be high because three distinctly different types of environments come together along rivers: 1) aquatic environments, represented by the mainstem channels, sloughs, oxbow lakes, and backwaters of the Tanana River and its tributaries; 2) terrestrial environments, represented by forest, shrub, and herbaceous communities that border the rivers and streams, as well as by upland communities found at greater elevations above or distances from water; and 3) wetland communities, represented by marshes, bogs, muskegs, and other intermittently wet environments that support plants adapted to the periodic depletion of soil oxygen. (Such conditions occur when soils are flooded for weeks or months each year.) Each kind of environment supports its own variety of habitats (conveniently categorized in terms of plant communities or landforms), and each habitat supports particular fish or wildlife species. In addition, "edges" between plant communities or landforms, for example where forest borders wetland marsh; and transition zones, or "ecotones," between them, as where boggy shrubland grades into well-drained shrubland or forest, are also characterized by their own collections of fish and/or wildlife.

The variety and spatial patterning of Tanana Basin flood plain plant communities create habitats for a large number of species. Plant communities (and other cover types) distinguished by the SCS during Tanana Basin cover type mapping are listed in Table 1. With the exception of some upland shrub and herbaceous types (SCS codes 63, 68, 72-76), all listed plant communities are represented in the flood plains of the Tanana River and its tributaries.

TABLE I. COVER TYPES MAPPED IN THE TANANA BASIN

FOREST

CONIFER FOREST

Closed Conifer Forest
- (1) Black Spruce
- (2) White Spruce
- (3) Black Spruce-White Spruce
- (4) Black Spruce-Tamarack
- (5) Tamarack

Open Conifer Forest
- (6) Black Spruce
- (7) White Spruce
- (8) Black Spruce-White Spruce
- (9) Black Spruce-Tamarack
- (10) Tamarack

Woodland Conifer
- (11) Black Spruce
- (12) White Spruce
- (13) Black Spruce-White Spruce
- (14) Black Spruce-Tamarack
- (15) Tamarack

DECIDUOUS FOREST

Closed Deciduous Forest
- (16) Balsam Poplar
- (17) Paper Birch
- (18) Aspen
- (19) Birch-Aspen

Open Deciduous Forest
- (20) Balsam Poplar
- (21) Paper Birch
- (22) Aspen
- (23) Birch-Aspen

Woodland Deciduous
- (26) Balsam Poplar
- (27) Paper Birch
- (28) Aspen
- (29) Birch-Aspen

MIXED CONIFOR DECIDUOUS FOREST

Closed Mixed Forest
- (30) Black Spruce-Birch
- (31) White Spruce-Birch
- (32) Black & White Spruce-Birch
- (33) Black Spruce-Aspen
- (34) White Spruce-Aspen
- (35) Black & White Spruce-Aspen
- (36) Black Spruce-Birch-Tamarack
- (37) White Spruce-Birch-Aspen
- (38) White Spruce-Balsam Poplar

Open Mixed Forest
- (40) Black Spruce-Birch
- (41) White Spruce-Birch
- (42) Black & White Spruce-Birch
- (43) Black Spruce-Aspen
- (44) White Spruce-Aspen
- (45) Black & White Spruce-Aspen
- (46) Black Spruce-Birch-Tamarack
- (47) White Spruce-Birch-Aspen
- (48) White Spruce-Balsam Poplar

CONIFER FOREST

Woodland Mixed Forest
- (50) Black Spruce-Birch
- (51) White Spruce-Birch
- (52) Black & White Spruce-Birch
- (53) Black Spruce-Aspen
- (54) White Spruce-Aspen
- (55) Black & White Spruce-Aspen
- (56) Black Spruce-Birch-Tamarack
- (57) White Spruce-Birch-Aspen
- (58) White Spruce-Balsam Poplar

SHRUBLAND

TALL SHRUB

Closed Tall Shrub
- (60) Willow
- (61) Alder
- (62) Alder-Willow
- (63) Mixed (Alder, Willow, Shrub Birch)

TALL SHRUB

Open Tall Shrub
- (65) Willow
- (66) Alder
- (67) Alder-Willow
- (68) Mixed (Alder, Willow, Shrub Birch) above forest below tundra
- (69) Sheperdia-Dryas

LOW SHRUB

Closed Low Shrub
- (70) Mixed (Dwarf Birch, Willow, Ericaceous)

Open Low Shrub
- (71) Mixed (Dwarf Birch, Willow, Ericaceous)
- (72) Mixed (Dwarf Birch, Willow, Ericaceous)

Dwarf Shrub Closed
- (73) Mat Cushion, Dryas, Ericaceous, willows, crowberry, cassiope, sedges

Dwarf Shrub Open
- (74) Mat Cushion, Dryas, Ericaceous, willows

HERBACEOUS

Dry
- (75) Bluejoint-Herb
- (76) Midgrass-Herb-Sedge

Moist
- (77) Sedge-Grass-seasonally flooded
- (78) Herb-Sedge-Grass

Wet
- (79) Wet sedge-Grass

AQUATIC

FRESHWATER
- (80) Water bodies greater than 20 acres
- (81) Water bodies greater than 20 acres with Floating and Submerged vegetation
- (82) Emergent vegetation
- (85) Water bodies less than 20 acres
- (86) Water bodies less than 20 acres with Floating and Submerged vegetation
- (88) Lower perennial streams and rivers
- (89) Upper perennial streams and rivers

BARREN-NATURAL
- (90) Intermittent stream channels
- (91) Para-riverine (sand and gravel bars)
- (92) Rock
- (93) Ice and snow

CULTURAL
- (94) Bare ground
- (95) Urban-Suburban
- (96) Agriculture
- (97) Gravel pits, mines, quarries
- (98) Roads
- (99) Pipelines and Powerlines

DESCRIPTORS

FORESTS - (Tree size class)
- D - Dwarf forests (Shrub-less than 20 feet mature)
- R - Reproduction (less than 5 inches DBH)
- P - Pole size (5-9 inches DBH coniferous, 5-11 DBH deciduous)
- S - Sawtimber size (greater than 9 DBH coniferous and 11 DBH deciduous)
- W -Wetland
- BR- Burned recently

Within habitat variety is also high in flood plains, and also contributes to the variety of animal species found there. This "structural diversity" within individual communities is created where plants of many shapes and sizes, particularly woody species of different heights, grow on the same plot of land. Such a variety of plant strata can develop where either woody canopies are open enough or clearings large enough to permit sun to reach all levels of vegetation from the ground up. Streams and rivers often provide such clearings for plant communities near the water's edge, so that along sufficiently wide waterways, bordering forests may support well-developed shrub understories and herbaceous groundcover. The result is the multi-layered pattern of vegetation common along many streams and rivers. Each layer provides food, cover, and space to different species of wildlife: thrushes and warblers occupy tree canopies, juncos and sparrows occur near the ground, woodpeckers use tree boles, red and flying squirrels nest and feed among tree branches, marten are active both on the ground and in the trees, hares feed and hide among shrubs, and other species occur wherever appropriate conditions are found.

TABLE 2.

MAMMALS USING TANANA BASIN RIVERINE HABITATS

(species followed by * are dependent on wetlands or riparian areas seasonally or year-round)

INSECTIVORES
- masked (common) shrew
- dusky shrew*
- arctic shrew*
- pygmy shrew

BATS
- little brown bat

CARNIVORES
- coyote
- grey wolf
- red fox
- black bear*
- brown bear*
- marten
- short-tailed weasel (ermine)
- least weasel
- mink*
- wolverine
- river otter*
- lynx

RODENTS
- arctic ground squirrel (parka squirrel)
- red squirrel
- northern flying squirrel
- beaver*
- northern red-backed vole
- meadow vole
- tundra (northern) vole*
- long-tailed vole
- yellow-cheeked vole*
- singing vole*
- muskrat*
- northern bog lemming
- meadow jumping mouse
- porcupine

LAGOMORPHS
- snowshoe hare

UNGULATES
- moose*
- caribou

Rivers and streams continually renew both within-habitat and between-habitat diversity on lands through which they flow. Flooding, shifts of channel, abandonment of oxbows, deposition of bars, etc. create new clearings, modify existing riparian communities, and initiate new stages of plant succession, all of which maintain the high variety of habitats present.

Flood plain wildlife diversity is also augmented by the fact that flood plains provide habitats, and hence wildlife species, found nowhere else. These include: a) species that feed primarily in water but nest or den in trees, banks, or burrows, for example: river otters, kingfishers, bald eagles, dippers, and a variety of ducks; as well as b) species that feed primarily on land but utilize water for cover, most notably the beaver. One threatened species*, the peregrine falcon, is also a user of study area flood plains. Peregrines are known to nest in cliffs along the Tanana River, and one peregrine nest has been noted within the study area (ADF&G 1983b). Mammals using study area flood plain habitats are listed in Table 2.

* Federal Register, Vol. 49 No. 50, March 20, 1984.

2. Flood plains and other riparian habitats generally support a higher abundance of wildlife than surrounding upland areas.

Plant productivity on flood plains is usually high because flood plains are generally characterized by level terrain, fertile soils (enriched by sediments deposited during periodic flooding), and plentiful water. High plant productivity means that relatively large populations of grazers and browsers (herbivores) can be supported. These in turn provide food for carnivores. Omnivores and scavengers are well provided for by both productive plants and the activities of other animal groups.

Wildlife populations inhabiting flood plains also benefit by having two distinct sources of food available to them: water and land. Many species of wildlife take advantage of both. Moose, for example, browse on terrestrial plants, particularly the young willows, alders, and cottonwoods found on recently exposed sandbars and banks, as well as on succulent aquatic vegetation found in sloughs, ponds, and wetlands. During winter, these flood plain plant communities become extremely important to moose because accumulating snows preclude use of upland shrub habitats heavily used during summer and fall. As a result, essentially all Interior river valleys are considered by the ADF&G to contain prime winter moose habitat. Muskrats consume aquatic, wetland, and some terrestrial vegetation, and take advantage of aquatic cover when harvesting and transporting food. Geese and dabbling ducks concentrate their feeding activities on aquatic vegetation but also consume grains in nearby fields. Bears and many furbearers, particularly mink and river otter, consume both aquatic foods, such as crustaceans, fish, and molluscs, and terrestrial foods, such as insects, small mammals, and berries. Flood plain habitats are usually important, and often critical, to maintenance of the bird and mammal populations that feed there.

3. Flood plains serve essential functions in maintaining aquatic habitats.

A variety of fish are harvested by recreational and subsistance users from the Tanana River and other rivers and streams in the study area. Species harvested include: king, chum, and coho salmon; rainbow trout; Dolly Varden; Arctic grayling; northern pike; whitefish; burbot; and sheefish. In addition to the Tanana River, eleven streams addressed in this study are listed by name in the ADF&G *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes* (ADF&G 1983a): Baker, Fish, Hutlinana, and Julius Creeks; Bearpaw, Kantishna, McKinley, Nenana, Toklat, Tolovana, and Zitziana Rivers.

Flood plains serve three main functions in protecting aquatic habitat quality, they: 1) help maintain water quality, 2) help stabilize stream banks and channels, and 3) moderate aquatic temperatures and riparian microclimates. Flood plain effectiveness in serving these functions is largely dependent on the amounts and kinds of riparian vegetation present: reduction in vegetation tends to reduce effectiveness.

Water quality can be affected by sediments, chemicals, or organic pollutants delivered from upslope areas. Flood plain vegetation, and watershed vegetation in general, is important in reducing these inputs by slowing overland runoff from storms or snowmelt. As flows are slowed, waterborne sediments and other solids are deposited, opportunities for runoff to infiltrate soils are increased, and less material is carried into streams and rivers. In addition, erosive capacities of surface runoff are reduced, so upslope soils are not as likely to be washed away and river banks are less likely to be gullied. Well-vegetated slopes and banks will be most effective in slowing runoff and reducing erosion.

The same processes occur during floods when floodwaters flow through flood plain vegetation. As they do, water velocities are reduced, deposition is increased (suspended sediments that settle out generally enrich flood plain soils), erosion is reduced, and stream banks are less likely to be undercut or washed away. The greater the "roughness" of the vegetation through which waters flow, the more effectively floodwater velocities are slowed, water quality is protected, and erosion is reduced.

Even without vegetation, flood plains help reduce floodwater velocities and depths. By providing broad areas over which flood waters spread, flood plains both increase area wetted and decrease water depth, both of which reduce water velocities. In addition, topographic depressions in flood plains, such as abandoned channels, oxbow lakes, potholes, and wetlands, can trap, retard, and "soak up" floodwaters, thus reducing velocity and depth of flood flows. Reduction in flow velocity protects water quality, minimizes erosion of stream banks and channel substrates, and helps vegetation withstand flood flows. Areas of slack water also provide refuges where aquatic organisms can find shelter from flood currents.

Finally, flood plain vegetation moderates and stabilizes water temperatures and riparian microclimates by: 1) filtering sunlight, 2) reducing radiation of heat from water and land surfaces, 3) reducing wind speeds in river corridors, 4) reducing convective heat loss from land and water, and 5) reducing snow accumulation. As a result, both aquatic and terrestrial species using vegetated flood plains are often provided with comparatively mild and stable microclimates.

4. Flood plains provide natural easily-traveled corridors interconnecting a variety of upstream and downstream habitats.

Streams and rivers form branching networks tying together all lands within individual watersheds. Where well-developed flood plains border these waterways, they provide particularly easy-to-travel "highways," and are used by many species during population expansions, irruptions, and relocations; seasonal migrations; and foraging forays. In particular, vegetated flood plains can provide continuous cover and plentiful food to many species, which is essential to animals moving through unfamiliar areas. Among species for whom flood plain corridors in the study area are particularly important are moose moving between upland summering and lowland wintering grounds, furbearers dispersing to new territories or seeking new prey concentrations, black and brown bears in seeking the earliest emerging vegetation in spring and salmon concentrations in summer or fall, and young beavers dispersing to new territories.

Specific fish and wildlife values of lands in the Tanana River Basin have recently been summarized by the ADF&G (October 1983). While some valuable locations may have been overlooked due to lack of information, the ADF&G summary provides the best information available on noteworthy fish and wildlife concentrations and habitats in the Tanana Basin. Appendix C summarizes ADF&G information related to the Tanana Flood Plain Management Study. As Appendix C shows, the flood plain study area contains many localities with very high fish and wildlife values. Principle among these are: Toklat River Springs (at the confluence of the Toklat and Sushana Rivers); Minto Flats, and associated lowlands south of the Tanana River (in the eastern portion of the study area), the Tanana Flats (east of the confluence of the Tanana and Nenana Rivers), and the Fish Lake-Fish Creek area (located at the western end of the study area). More detailed information on particular areas is contained in the "fish and wildlife element" prepared by the Habitat Division, ADF&G, Fairbanks, for the Fairbanks office of the ADNR as part of the Tanana Basin Area Plan (1983b).

II. Cultural Values:

1. Flood plains reduce effects of flooding.

As described under biological values, flood plains have important effects on flooding, and conversely, flooding has significant effects on flood plain topography, soils, and ecology. Of particular importance to man are the ways in which flood plains reduce flood severity. As noted above, flood plains provide a broad area over which flood waters spread, thereby reducing flow velocities and lowering flood peaks. Flood waters are trapped and held back as they overflow the flood plain and refill wetlands and topographic depressions. This entrapment, plus the meandering of streams, the retardation of water by vegetation, and other natural processes common to undisturbed flood plains, reduce severity of downstream flooding.

2. Flood plains help maintain water quality, as well as stability of stream banks and channels.

As discussed under biological values, flood plains, particularly when well vegetated, reduce velocities of both overland runoff and flood flows. In both cases, the result is reduced erosion, increased settling out of waterborne material, stabilization of stream banks and channels, and protection of water quality. These effects benefit human users of flood plain areas and adjacent water bodies.

3. Flood plains provide areas for groundwater recharge and help to maintain water levels in surface water bodies and aquifers.

As mentioned above, when streams and rivers overflow their active channels and spread across adjoining flood plains, topographic depressions and adjoining wetlands trap and "soak up" floodwaters. These natural holding ponds provide areas for flood water storage. In addition to slowing flood flows and reducing erosion and downstream siltation, this permits surface waters to permeate down to groundwater reservoirs (aquifers) and replenish them. During dry seasons, groundwater flows from aquifers into channels and basins having water levels below the local water table. Such groundwater outflow may be the primary source of water in some lakes and streams during low-flow periods. Many aquifers providing important sources of water used by human settlements are recharged primarily from nearby flood plains.

4. Flood plains provide unique high-quality subsistence and recreational opportunities.

Since prehistoric times, human cultures have focused their activities along streams and rivers because of the ease of travel on waterways — with

boats in summer, sleds (and now also snowmachines and 3-wheelers) in winter — and because of the tendency of streams and rivers to concentrate and funnel fish and wildlife. Until recently, human activities in these areas have been exclusively or primarily subsistence oriented, and in many rural areas, this is still the case. In addition, however, riverine and flood plain resources are also being used by growing numbers of recreationists seeking many of the opportunities subsistence users have long valued: diverse and abundant fish and wildlife resources; varied and unique scenery; water-related transportation, or in winter, easy travel along frozen waterways. The popularity of fishing, rafting, kayaking, canoeing, dog mushing, trapping, and hunting on and adjacent to the Tanana River and its tributaries is evidence of the high harvest and recreational values associated with rivers, streams, and riparian corridors. Because of their continuity, long linear extent, and diverse scenery, these corridors are particularly well suited for extended recreational trips. As should be clear from previous discussions, flood plains are important in maintaining the riparian and riverine resources valued by human users, and themselves often provide ideal hiking trails, camp sites, hunting areas, or other natural opportunities. River corridors in the study area currently supporting highest numbers of human users (generally because of good riverboat access) include: the Tanana River; the lower reaches of the Nenana, Kantishna, Toklat, Tolovana, Tatalina, Wood, and Chatanika Rivers; Minto Flats (accessed by Tanana, Chatanika, and Tolovana Rivers and by Swanneck Slough); Fish Lake (accessed by the Tanana River), and almost all rivers and streams crossed by roads. Human uses of flood plain fish and wildlife are included in the ADF&G "fish and wildlife element" for the Tanana Area Plan (1983b).

FLOOD HISTORY

Development in the study area is sparse, and historical information on floods is almost nonexistent. Local people who were contacted identified some isolated flood problems, mostly in summer fish camps that get flooded every few years. The village of Minto has been relocated due to frequent flood damages incurred in its former location.

Manley Hot Springs experienced flood damages in 1962 and 1965. The village of Tanana was flooded to some extent in 1937 and 1964. Nenana was completely inundated in 1967. There were 128 houses flooded from this event from the Tanana River. Nenana received some damages in 1971. Many bridges and culverts over streams are damaged to some extent annually.

Channel obstruction is a significant factor in assessing flood damage. Ice jams, stream glaciation, and log jams have been witnessed in the study area and are considered frequent occurrences on many study area streams. Sufficient data are not available for analyzing frequencies and locations of potential damage caused by such channel obstructions.

Channel bank erosion is taking place along most of the major streams. Much of the bank erosion is accelerated by the large ice flows during spring breakup.

Source: SCS

Tanana River has a wide flood plain with many high-flow side channels; these are full in this photograph. (June 1982)

Source: SCS

Streams in the study area were flowing bankfull and the Tanana River was overflowing its banks in July 1983.

Source: SCS

Estimated 5-year frequency high water line at Tanana. Highwater and debris cause damage. (July 1983)

FLOOD POTENTIAL (PRESENT CONDITIONS)

The flood management area maps in this report reflect land uses and channel conditions existing as of 1983.

Flood Hazard Areas

Present damageable property in the study area consists of residences, scattered cabins, fish camp facilities, highways, bridges, and culverts. The fish camp facilities receive mostly seasonal use. Several bridges along the Parks and Elliot Highways and residences and businesses in several communities are vulnerable to substantial amounts of flood damage. It is estimated that damages to these structures from a 100-year event would be about $5,150,000; average annual damage currently totals $309,000.

A detailed damage analysis assessing the effect of flooding on stream fishing is beyond the scope of this study; however, under certain conditions, flooding could severely disrupt stream sports fisheries and have a long-term negative impact on commercial fisheries. See Appendix B, Exhibit 2, for area flooded along study streams by the 100-year event. The area subject to inundation by the 100-year frequency storm event under present conditions is about 2,000,000 acres.

The developed areas in the villages of New Minto and Eureka are located on high banks and will receive very little if any damage from a flood discharge equal to a 100-year or a 500-year frequency event. Ice and debris are always threats during spring breakup flows. Tanana, Manley, and Livengood will receive some flood damages from the infrequent storms. Ice jams could create dams in many locations along the Tanana River and its tributaries, backing up water and threatening floods when sudden breaks in the ice jams release surges of water and ice many feet deeper than normal flow. The same danger exists when trees and logs are washed downstream, hang up, and dam the main channels of area streams and rivers.

Four valley cross sections on the Tanana River, "A", "B", "C", and "D", were located by use of USGS topographic quadrangles and aerial photography for development of stage-discharge curves to determine area inundated. Section "A" is located about 7.5 miles downstream of the

village of Tanana; section "B" is located about 6.5 miles downstream of Manley Hot Springs; section "C" is located about 21 miles downstream of Minto at the west end of Minto Flats; and section "D" is located just above the village of Nenana.

The water surface at cross section "A" will have a backwater effect at the village of Tanana. The 10-year event will back water into Tanana about 3 feet deep on Beacon Street. The 100-year event will back water into parts of Tanana about 10 feet deep, which would flood 20 or 30 houses up to 10 feet deep. Water surface is calculated at about elevation 237.0 as interpolated from the USGS quadrangle sheets.

At section "B" the water surface will back water into Manley Hot Springs and cause some flooding to residences and businesses. Fifteen to 20 houses may be flooded several feet deep from the 100-year event. The 100-year water surface is calculated to be at about elevation 274.0.

At section "C" the 100-year water surface, at about elevation 317.0, will back into the Minto Flats area. Much of the area will be inundated 30 feet deep. Several homes and cabins will be damaged. The Old Minto (abandoned) area will be flooded several feet deep. There will be very little if any flood damage in Minto. Livengood and Eureka have very little flood damage potential.

At section "D" the 100-year water surface is at about elevation 360.0 and will damage about 130 residences and businesses. Depth of flooding will vary from one foot to several feet in the first floor levels. Streets and utilities will be damaged to some extent.

The communities adjacent to the Nenana River and tributaries are above the 100-year water surface but damages may occur when ice jams, ice dams, or log jams are formed in the streams. Twenty-six of the twenty-seven bridges involved in this study will convey the 100-year peak flow without their structures being overtopped; however damage to the structures will be caused by the high velocities through the bridges. The highway north of Fish Creek will be overtopped and minor flood water damage will occur to the highway.

Manley Hot Springs flood of 1956 caused by ice jam.

Source: U.S. Air Force

Technical Data and Related Material

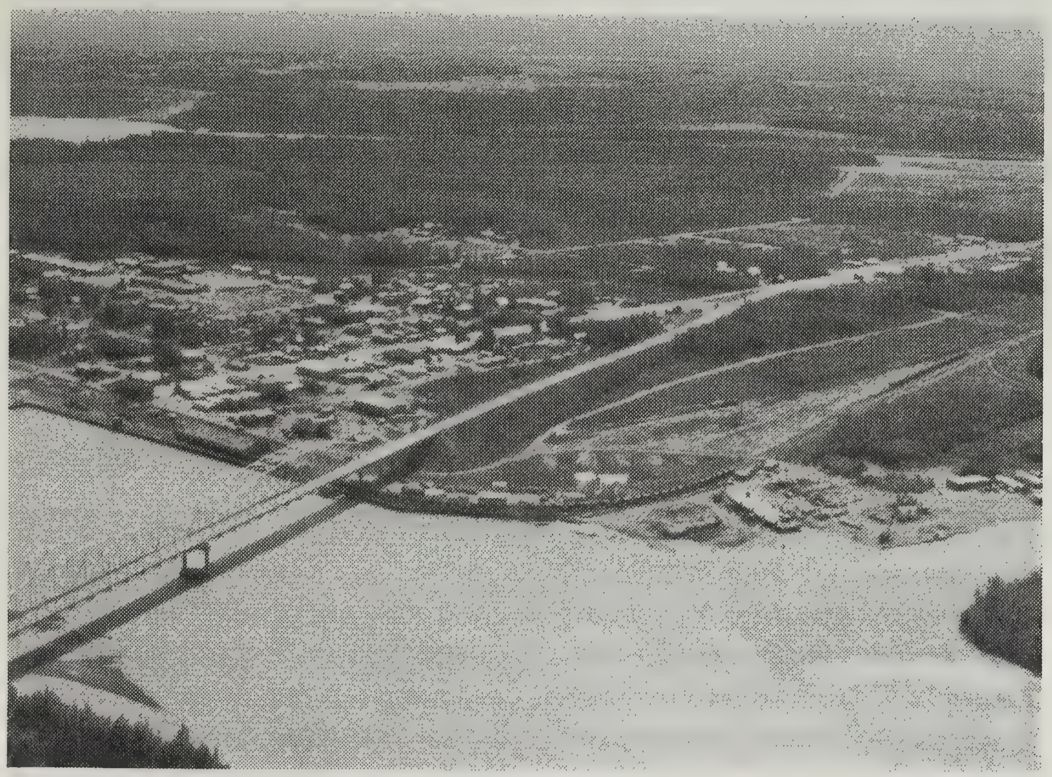
The technical data and related material developed to assist intended users of this study are provided as figures, exhibits, and tables in this report.

The Tanana River channel is about 23 feet deep at bankfull flow and the slope is about 0.5 feet per mile from Minto to Tanana. In this reach, the flood plain is flat and wide, averaging 2 miles in width in most locations, but increasing to 5 or 6 miles in the Minto Flats. The 10-year frequency event exceeds channel capacity and overflows into the flood plain.

The Flood Plain Management Maps, Exhibit 2 of Appendix B, show areas inundated by the 100-year flood. The limits of the 100-year flood line are approximate and may vary on the ground somewhat from that shown.

These flood plain management maps can be used to determine the location of points in question and their relationship to the 100-year frequency flood. They may be used for flood plain management decisions, general planning, and other purposes that require the approximate location of the 100-year flood plain.

Basic data used for determining flood hazard information and for analyzing peak discharge frequency in this report are on file in the office of the U.S. Department of Agriculture, Soil Conservation Service, 2221 E. Northern Lights Blvd., Suite 129, Anchorage, Alaska 99504.



Source: SCS

Nenana community on the Tanana River. (July 1983)

FUTURE FLOOD POTENTIAL

Nenana is a participant in the National Flood Insurance Program, however, the villages of Tanana, Manley Hot Springs, Eureka, Minto, Livengood, Cantwell, Windy, and Healy are not participants in the program which is administered by the Federal Emergency Management Agency. The State is a strong advocate of the program. Participation in the flood insurance program guarantees that federally subsidized flood insurance coverage is available to owners and occupiers of all buildings and mobile homes. Although villages in the study area, except Nenana, are not currently eligible to participate formally in the program because of their status as unincorporated communities and have no land use control, they are interested in knowing where the flood boundaries are located. Flood boundary information can provide villages, as well as state and federal agencies, with information needed to guide development, site new facilities, and make land selection and disposal decisions.

The villages that have not adopted land use management regulations, as such, currently implement the intent of such regulations by keeping new development out of the flood plain when possible.

State and federal agencies are obligated to regulate their activities to meet minimum flood plain requirements. These minimum requirements, based on approximate flood boundary information provided, include:

- insuring that all new construction 1) is designed to minimize flood loss, 2) is anchored to prevent movement or collapse, 3) uses flood-resistant materials and equipment, and 4) uses construction methods and practices to minimize flood damage.

- insuring that new developments and subdivisions 1) minimize flood damage, 2) locate and construct new utilities in ways that minimize or eliminate flood damage, 3) provide adequate drainage, 4) safeguard new water or sewer systems to avoid infiltration or impairment by floods.

In addition to the above, cities and boroughs participating in the NFIP at the entry (Emergency Program) level with flood boundary maps only (no flood elevations) must:

- require building (or land use) permits;
- review permit applications to determine if a site is reasonably free from flooding;
- regulate special flood hazard areas;
- regulate mobile home siting, tie-downs, and anchoring.

With flood plain boundaries defined, it is expected that future residential, commercial, and industrial flood plain development will be planned so that flood damages to these properties will not increase above present levels. This presupposes that the flood plain information will be used as a planning tool and as a means for adopting and enforcing ordinances for flood plain management. Should this fail to occur, damage potential will increase with population growth.

FLOOD PLAIN MANAGEMENT

Management Programs

When adopted, regulatory measures will not prevent flooding; instead they reduce the threat of damage or loss of life from floods by discouraging development of homes and other buildings on flood plains. Without additional measures, damage to existing property will continue, and road and bridge-related damages are likely to increase. As a means to minimize such damage, the following alternatives are suggested.

1. For Existing Properties

   a. Incorporate permanent structural measures as integral parts of existing structures, such as raising the elevation of structures, waterproofing basement and foundation walls, anchoring and reinforcing floors and walls, and using water-resistant materials.

   b. Design contingency measures and outline the actions to be taken to make them effective, such as a flood warning system and removable bulkheads.

   c. Ensure that emergency measures will be carried out during floods according to prior emergency plans; emergency measures include sandbagging, pumping, and removal of building contents to flood-free areas.

   d. Undertake reclamation of flood plains, including permanent evacuation of developed areas that are subject to inundation, acquisition of these lands by purchase or land trades, removal of structures, and relocation of populations from such areas.

   e. Use flood watch or warning systems to provide advance notice of impending flood danger.

   f. Ensure that buildings and mobile homes within or adjacent to the delineated flood hazard areas in Appendix B of this report carry flood insurance on structure and contents. Although this will not reduce existing damage potential, it will have the positive effect

DATA LIMITATIONS

The depth data presented in this report and the inundation area shown on the flood plain management maps, Appendix B, Exhibit 2 should be considered minimum estimates. During flood flows, ice and debris may obstruct river channels, partially blocking or even damming them in some instances, causing greater water depths and wider flood plains than are indicated in Exhibit 2. Since the occurrence and effects of such factors cannot be determined, only present physical characteristics of the channels and other available data were used in calculations presented in this report. For this reason it is recommended that a safety factor (free board allowance) be included in any development.

of reducing costs to those receiving damages by spreading those costs among everyone in the flood insurance program.

2. For Future Road and Bridge Construction

   a. When analyzing proposed alternative transportation routes, the costs of potential flood damage should be investigated and included for use in the decision making process.

   b. Construction designs should reflect sound engineering judgment with regard to flood hazard potential. Engineering should include analysis of soils, geology, hydrology and hydraulics, as well as adequacy of construction materials.

Floodway

The floodway consists of the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order for the 100-year flood to be carried without substantial increases in flood heights. Floodways were not determined in this study because it is assumed that local actions will be taken to prevent any further encroachment on the flood plains.

Recommendations

It is not the intent of this report to provide solutions to flood problems in the study area but to furnish an information base for the adoption of an overall flood plain management program. Other management programs affecting environmental values of flood plains may also benefit from this information. Following are recommendations which should be emphasized during development and implementation of this program.

1. As a minimum, adopt and enforce flood plain regulations in compliance with the National Flood Insurance Program. Regulations should address such things as minimum floor elevations, floodways, greenbelt areas, adequate drainage facilities, building and housing codes, and sanitary codes, with specific flood hazard provisions for all new construction.

2. Consider nonstructural measures for flood prevention such as flood plain acquisition, flood proofing, and flood forecasting and warning systems. Federal cost sharing for these measures may be available under Section 73(b) of Public Law 93-251. The National Weather Service of the National Oceanic and Atmospheric Administration issues frequent warnings of potential flood producing storms. Frequently the flood warnings are preceded by a "severe weather or flood watch."

3. Include in land development ordinances provisions for on-site runoff and sediment storage. A continuous maintenance program needs to be provided for these types of measures.

4. The State should take whatever actions are necessary to make flood insurance available to owners of property subject to flood damage (including areas adjacent to the delineated flood hazard areas), and owners should be encouraged to purchase flood insurance for buildings, mobile homes, and their contents. Villages interested in participation in the National Flood Insurance Program, and in determining regulatory requirements needed before flood insurance is available, should contact the State Department of Community and Regional Affairs.

5. Develop, when needed, a regular maintenance program to keep all hydraulic structure openings, approach channels, and outfall channels clear of sediment and debris.

INVESTIGATIONS AND ANALYSES

The hydraulic and hydrologic investigations performed during this study followed procedures in the SCS publication *National Engineering Handbook*, Section 4, Hydrology (NEH-4) and Section 5, Hydraulics (NEH-5), and other technical references.

Hydraulics

Stage- (water surface elevation) discharge relationships were developed for a few valley sections assuming normal flow and using Manning's flow equation. Hydraulic parameters characterizing channel and flood plain conditions up to 1983 were used in the computations. High water marks,

stream gage records, and other historical flood data were used in checking the accuracy of the computed water surface. Four recording stream gages were located in the study area. One gage is in Bridge Creek, a second is in Brooks Creek tributary, a third in Globe Creek, and a fourth in Globe Creek tributary, all near Livengood; these provide records that can be used for peak-frequency analysis and for checks against the calculated hydraulics. There are three miscellaneous stations with miscellaneous peaks calculated.

Hydrology

Studies of the frequency of peak flows (annual series) were made by the USGS for all of Alaska. The USGS published a regional analysis, *Flood Characteristics of Alaskan Streams* (Water Resources Investigations 78-129, dated 1979) that presents regional equations for two hydrologic areas in Alaska, Area II - most of mainland Alaska; and Area I - Kodiak, Kenai Peninsula south of Kenai Mountains, Prince William Sound, Panhandle and Southeast Alaska.

The study area is located in Area II. Peak-frequency curves were developed using the equation proposed by USGS and by use of the Log-Pearson Type III method. Peaks calculated by these two methods for given storm frequencies were compared to one another to determine the adequacy of the regional equation for this study. From these comparisons, it was determined that the regional equation developed by the USGS was inadequate and the following method was used to develop peak-frequency curves.

Twenty-six stream gages within the Yukon region of Alaska were used to develop peak-frequency curves in an effort to obtain more reliable peaks for the study area.

The Log-Pearson Type III method for frequency analysis was used to develop peak-frequency curves for each stream record and a curve was developed using the regression analysis. Using this curve as a basis, curves representing probable upper limits for high peak discharges and lower limits for low peak discharges were determined for the 2-year and 100-year events. These curves, along with watershed characteristics such as watershed slope, channel length and slope, mean elevation, land cover, and average annual precipitation, were used to develop a peak-frequency curve for each watershed of interest.

The peak discharge for each area of concern for the 10-, 50-, 100-, and 500-year storm events was obtained from these curves and used to determine the approximate area inundated.

GLOSSARY

ANNUAL SERIES - A frequency series in which only the largest value in each year is used, such as largest annual floods.

CFS - Abbreviation for cubic feet per second. The rate of discharge or flow of water representing a volume of 1 cubic foot passing a given point during 1 second.

CHANNEL - A natural or artificially created open conduit that periodically or continuously conveys water. River, creek, stream, branch, and tributary are some of the terms used to describe channels.

CROSS SECTION (stream or valley) - The shape of a channel, stream, or valley viewed across the axis. In watershed investigations, it is determined by a line approximately perpendicular to the main path of water flow, along which measurements of distance and elevation are taken to define the cross-sectional area.

CSM - Abbreviation for cubic feet per second per square mile. (Rate of discharge per square mile of drainage area.)

DISCHARGE - Rate of flow at a given instant in terms of volume per unit of time, e.g. cubic feet per second (cfs).

DRAINAGE AREA - (D.A.) The area, measured in a horizontal plane, which drains into a stream at a specified location. See *watershed*.

EROSION - Detachment and movement of soils or rock fragments by water, wind, ice, or gravity.

FLOOD - Overflow onto or inundation of normally dry lands from a stream or other body of water; the high streamflow overtopping the banks of a stream; or a high flow as measured by either stage or discharge.

FLOOD CREST - The maximum stage or elevation reached by the waters of a flood at a given location.

FLOOD FREQUENCY - The average interval of time between floods equal to or greater than a specified discharge or stage. It is generally expressed in years. Following are examples:

10-year flood or 10-year frequency flood. The flood which can be expected or exceeded on an average once in 10 years, and which would have a 10 percent chance of being equaled or exceeded in any given year.

50-year flood . . . two percent chance . . . in any given year.

100-year flood . . . one percent chance . . . in any given year.

500-year flood . . . two-tenths percent chance . . . in any given year.

FLOOD HAZARD - A general term meaning the risk to life or damage to property from: overflows of river or stream channels, extraordinary waves or tides occurring on lake or estuary shores, floodflows in intermittent or normally dry streams, floods on tributary streams, floods caused by accumulated debris or ice in rivers, or other similar events.

FLOOD HAZARD AREA PHOTOMAP - A photographic background map that indicates areas likely to be flooded by the 100-year frequency or the one-percent-chance flood (a flood having one chance in 100 of being equaled or exceeded in any given year) from an adjoining stream or water body.

FLOOD PEAK OR PEAK DISCHARGE - The highest value of the stage or discharge attained at a given point during a flood event, thus, peak stage or peak discharge.

FLOOD PLAIN OR FLOOD-PRONE AREA - The land area situated on either side of a channel or body of water that is subject to flooding.

FLOOD PLAIN MANAGEMENT - The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works, and land use and control measures.

FLOOD ROUTING - Determining the changes in a flood wave as it moves downstream through a valley or through a reservoir (then sometimes called reservoir routing). Graphic or numerical methods are used.

FREQUENCY-DISCHARGE-ELEVATION - The relationship between the frequency of particular discharges and the water elevations resulting from these discharges at surveyed cross sections or other points along a stream; may be shown as a plotted curve or in table form.

GREENBELT AREA - A strip of land kept in a natural or relatively undeveloped state, or in agricultural use, established around urban developments or along the flood plain of a stream or body of water.

HEADWATER - (1) The source of a stream. (2) The water upstream from a structure or point on a stream.

LEFT FLOOD PLAIN - The flood plain on the left side of a river, stream, or water course, looking downstream.

MANNING'S "n" VALUE - A coefficient of roughness in Manning's flow equation for determining stream velocities.

MSL - Abbreviation for mean sea level.

RIGHT FLOOD PLAIN - The flood plain on the right side of a river, stream, or watercourse, looking downstream.

RUNOFF - That portion of the precipitation on a drainage area that is discharged from the area in stream channels. Types include surface runoff, ground water runoff, or seepage.

SEDIMENT - Solid material, both mineral and organic, that is in suspension and is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface.

STAGE - Elevation of a water surface above any chosen datum plane, often above an established low-water plane; guage height.

STREAM - Any natural channel or depression through which water flows either continuously, intermittently, or periodically, including modifications of natural channels or depressions.

STRUCTURE - Anything constructed or erected by human society that requires a more or less permanent location on or in the ground, including but not limited to bridges, buildings, canals, dams, ditches, diversions, irrigation systems, pumps, pipelines, railroads, roads, sewage disposal systems, underground conduits, water supply systems, boat docks, and wells.

SUPERCRITICAL FLOW - Those conditions of flow for which the depth is less than critical and the velocity is greater than critical. Critical flow is the term used to describe open channel flow when the discharge is maximum for a given energy head, or stated conversely, when the specific energy head is minimum for a given discharge.

WATERSHED - The area contributing runoff directly to a stream; usually it is assumed that base flow in the stream also comes from the same area, however, the ground water watershed may be larger or smaller.

CONVERSION TABLE

Multiple inch-pound units	by	to obtain SI* (metric) units
cubic feet per second (ft^3/s)	0.0283	cubic meters per second (m^3/s)
cubic feet per second per square mile [$(ft^3/s)/mi^2$]	0.0109	cubic meters per second per square kilometer [$(m^3/s)/km^2$]
square miles (mi^2)	2.589	square kilometers (km^2)
acres	0.405	hectares
feet (ft)	0.3048	meters (m)
inches (in.)	2.540	centimeters (cm)
degrees Fahrenheit (degrees F)	5/9 (degrees F-32)	degrees Celsius (degrees C)

*Systems Internationale

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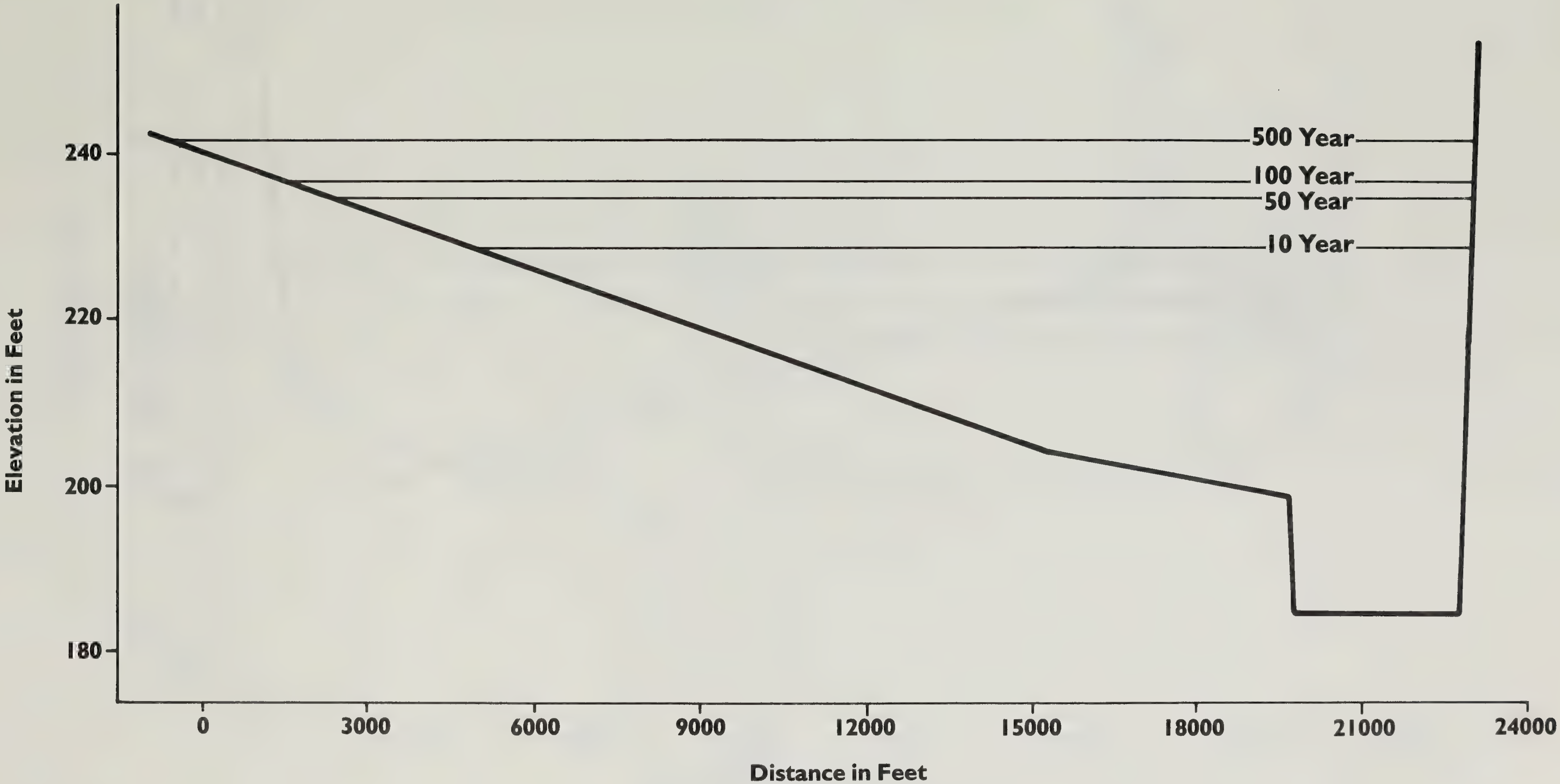
APPENDIX A

FIGURES 2. - 5.
TYPICAL VALLEY SECTIONS

TABLE 3.
FREQUENCY-DISCHARGE DATA

FIGURE 2.

SECTION A TANANA RIVER
TYPICAL VALLEY SECTION
Present Conditions



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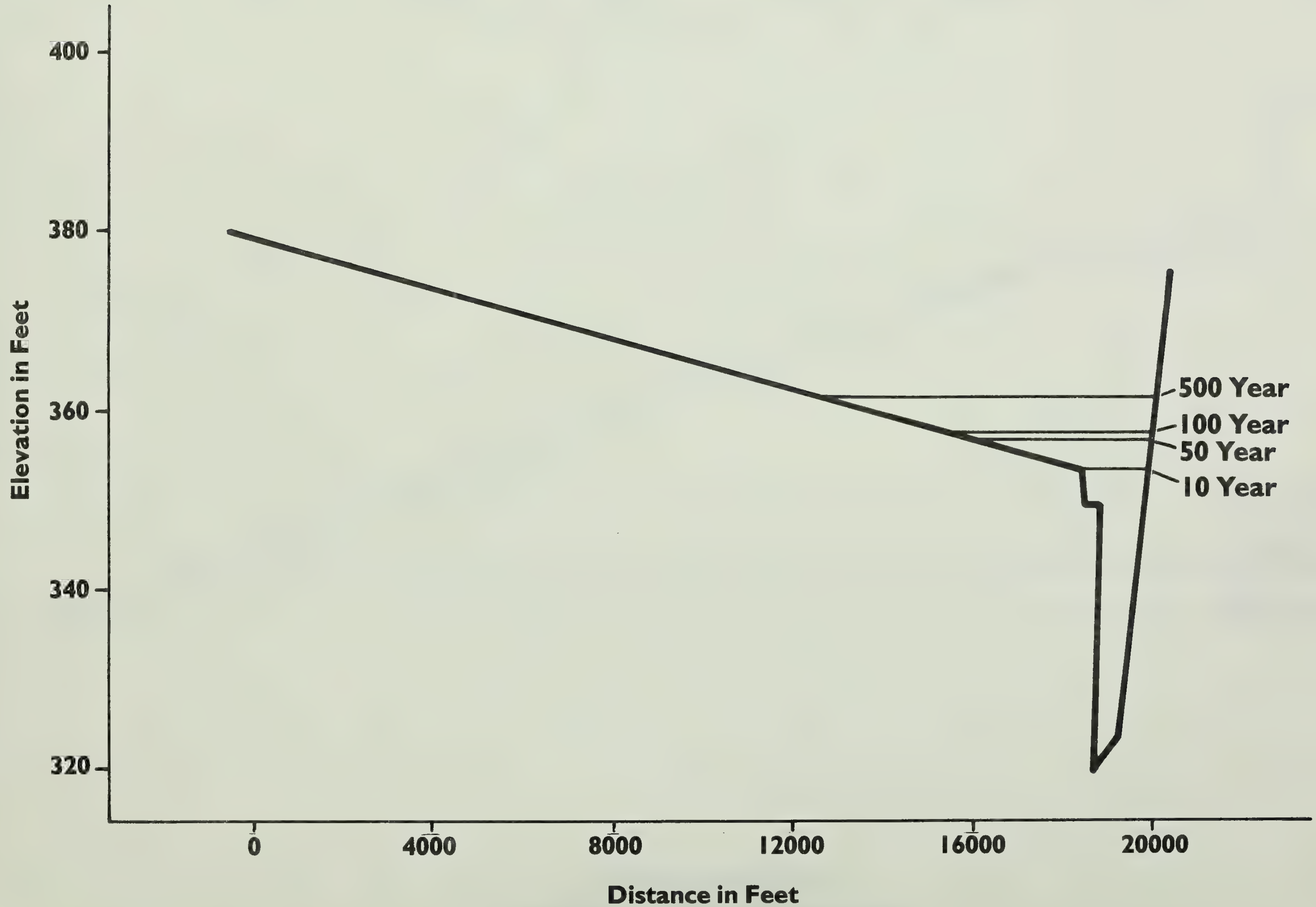
Tanana River Basin
Interior, Alaska

FIGURE 3.

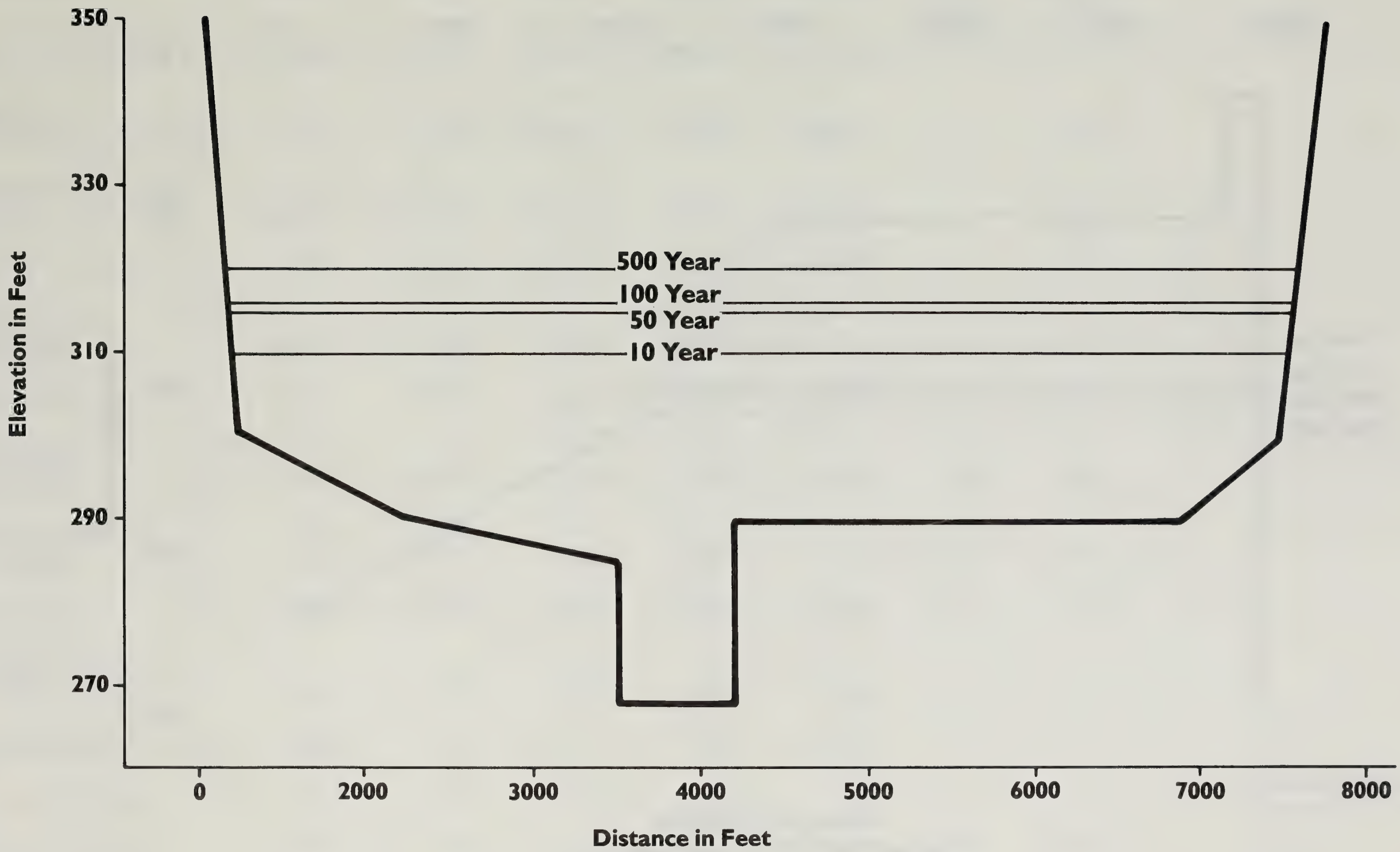
SECTION B TANANA RIVER
TYPICAL VALLEY SECTION
Present Conditions



Soil Conservation Service
U.S. Department of Agriculture
Tanana River Basin
Interior, Alaska

FIGURE 4.

SECTION C TANANA RIVER
TYPICAL VALLEY SECTION
Present Conditions



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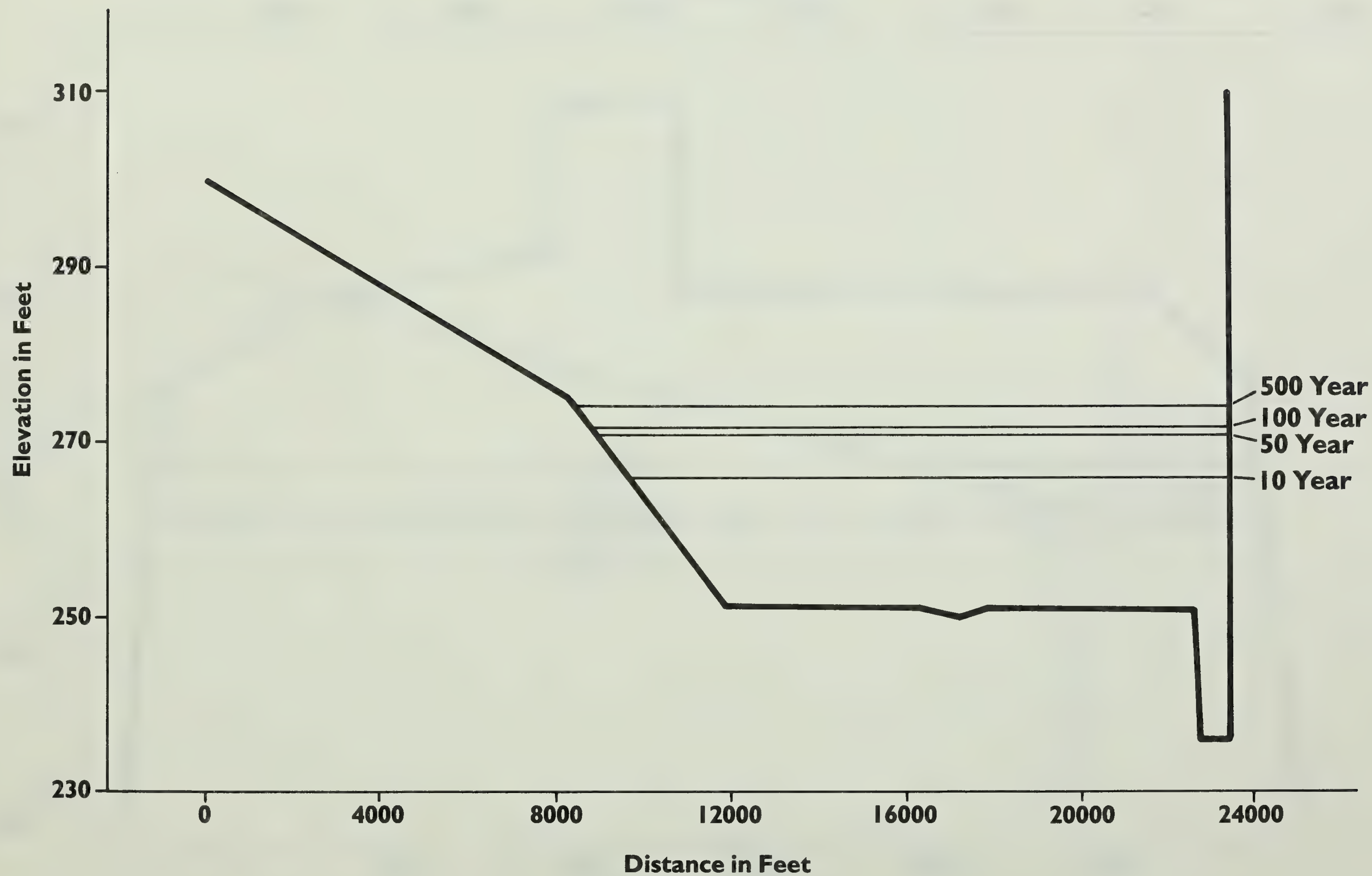
Tanana River Basin
Interior, Alaska

FIGURE 5.

SECTION D TANANA RIVER
TYPICAL VALLEY SECTION
Present Conditions



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Tanana River Basin
Interior, Alaska

TABLE 3.
PRESENT CONDITIONS: FREQUENCY-DISCHARGE AND WATER SURFACE DATA LOWER TANANA RIVER, INTERIOR REGION, ALASKA

Stream Name	D.A.	Peak Discharge (c.f.s.)				Water Surface	
and/or Reach	Sq. Mi.	10-Year	50-Year	100-Year	500-Year	Bridge No.	Elev. (MSL) (feet)
Yukon (at Tanana "A")	245,586.0	970,000	1,130,000	1,200,000	1,360,000	—	237.0[1]
Tanana River (at Yukon Confluence)	45,139.0	255,000	330,000	360,000	430,000	—	237.0[1]
(at Manley Hot Springs "B")	42,264.0	247,000	318,000	350,000	418,000	—	274.0[1]
(at Minto "C")	41,128.0	234,000	301,000	330,000	400,000	—	317.0[1]
Chatanika River (at mouth)	1,050.0	12,700	19,800	23,100	32,000	—	317.0[1]
Globe Creek	30.0	710	1,350	1,700	2,640	1,394	676.6
Tatalina River (at bridge)	90.0	1,790	3,150	3,900	5,850	1,400	462.8
Tolovana River (at bridge)	144.0	2,700	4,800	5,900	8,950	400	613.4
(at Minto)	1,013.0	12,700	19,800	23,000	32,000	—	317.0[1]
Livengood Creek (at upper bridge)	28.0	710	1,350	1,700	2,640	—	4.0*
(at middle bridge)	28.0	710	1,350	1,700	2,640	—	11.0*
(at lower bridge)	28.0	710	1,350	1,700	2,640	—	5.0*
(at highway bridge)	33.0	870	1,550	1,900	2,850	1,434	521.5
Lost Creek (at culvert)	53.0	1,170	2,170	2,700	4,200	[2]	634.0[1]
West Fork Tolavana (at bridge)	296.0	4,670	7,700	9,400	13,200	325	422.0

[1] Estimates from USGS Topographic Quads

[2] Culverts

[3] No depth estimates made

* Stage feet from channel bottom

TABLE 3.
PRESENT CONDITIONS: FREQUENCY-DISCHARGE AND WATER SURFACE DATA (CONTINUED)
LOWER TANANA RIVER, INTERIOR REGION, ALASKA

Stream Name	D.A.	Peak Discharge (c.f.s.)				Water Surface	
and/or Reach	Sq. Mi.	10-Year	50-Year	100-Year	500-Year	Bridge No.	Elev. (MSL) (feet)
Hutlinana Creek (at bridge)	82.0	1,650	2,960	3,650	5,600	—	627.0
Baker Creek (at bridge)	216.0	3,880	6,800	8,400	12,400	—	9.0*
Blowback Creek (at bridge)	4.0	115	315	410	690	—	769.0[1]
Kantishna River (at Toklat River)	5,596.0	48,000	68,500	78,000	101,000	—	[3]
(at mouth)	7,286.0	59,000	84,000	95,000	122,000	—	[3]
Toklat River (at mouth)	1,350.0	15,500	24,000	28,000	38,500	—	[3]
Zitziana River (at mouth)	738.0	9,300	14,600	17,300	24,000	—	[3]
Cosna River (at mouth)	598.0	8,100	13,100	15,500	21,800	—	[3]
Chitanana River	685.0	9,300	14,600	17,300	24,000	—	[3]
Pass Creek	23.0	1,080	1,820	2,180	3,190	293	2,147.0
Cantwell Creek	314.0	8,900	15,300	15,400	20,600	—	2,125.0[1]
Jack River Bridge	193.0	5,800	8,900	10,300	14,100	302	2,143.5
Nenana River Bridge	710.0	18,600	26,000	29,000	36,500	1,243	2,029.0
Carlo Creek Bridge	17.0	890	1,530	1,850	2,700	693	2,003.5[1]
Nenana River Bridge	1,206.0	24,800	34,000	38,000	48,000	694	1,805.0[1]
Riley Creek Bridge	138.0	4,600	7,100	8,400	11,500	695	1,570.0

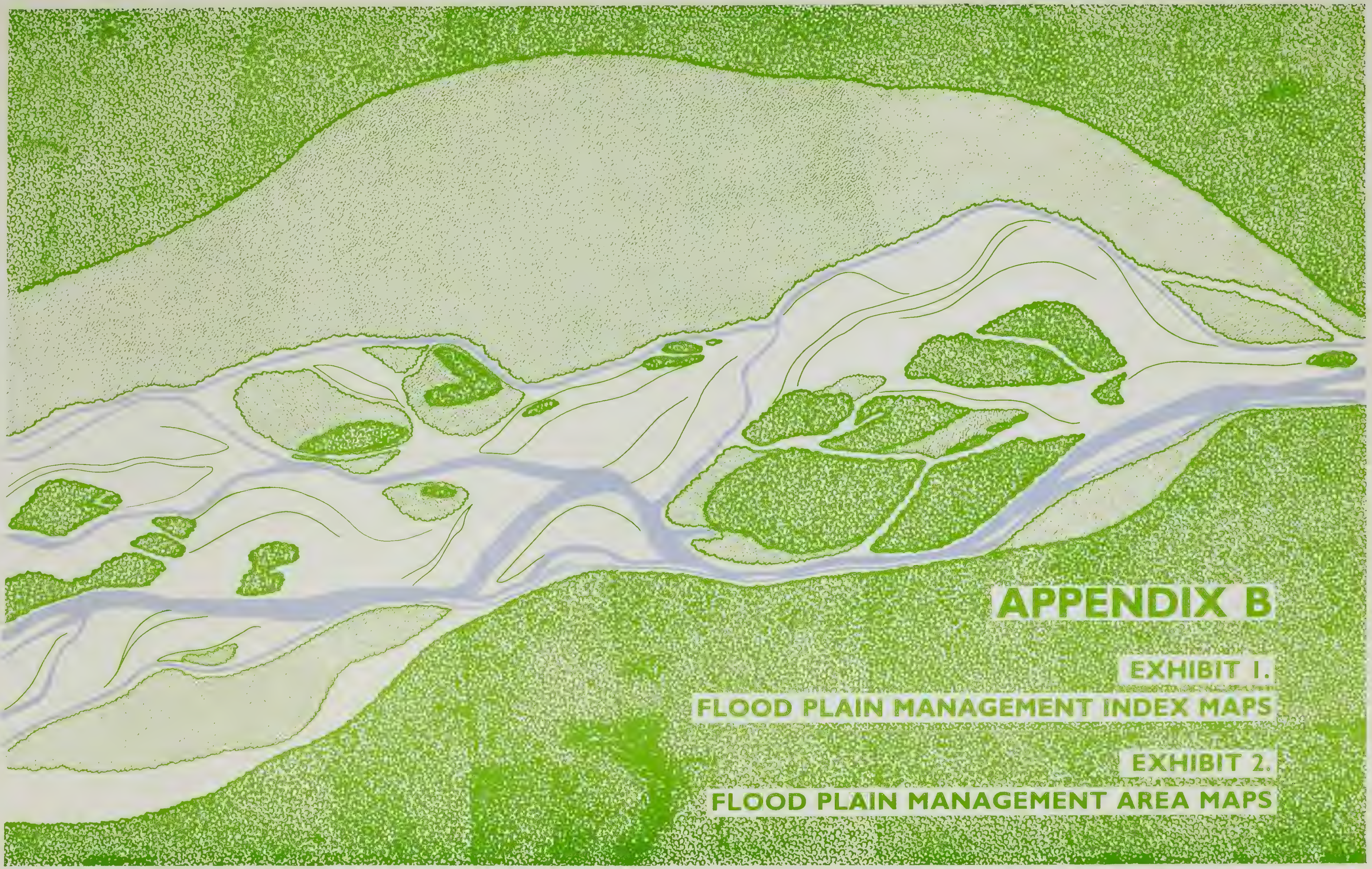
[1] Estimates from USGS Topographic Quads

[2] Culverts

[3] No depth estimates made

* Stage feet from channel bottom

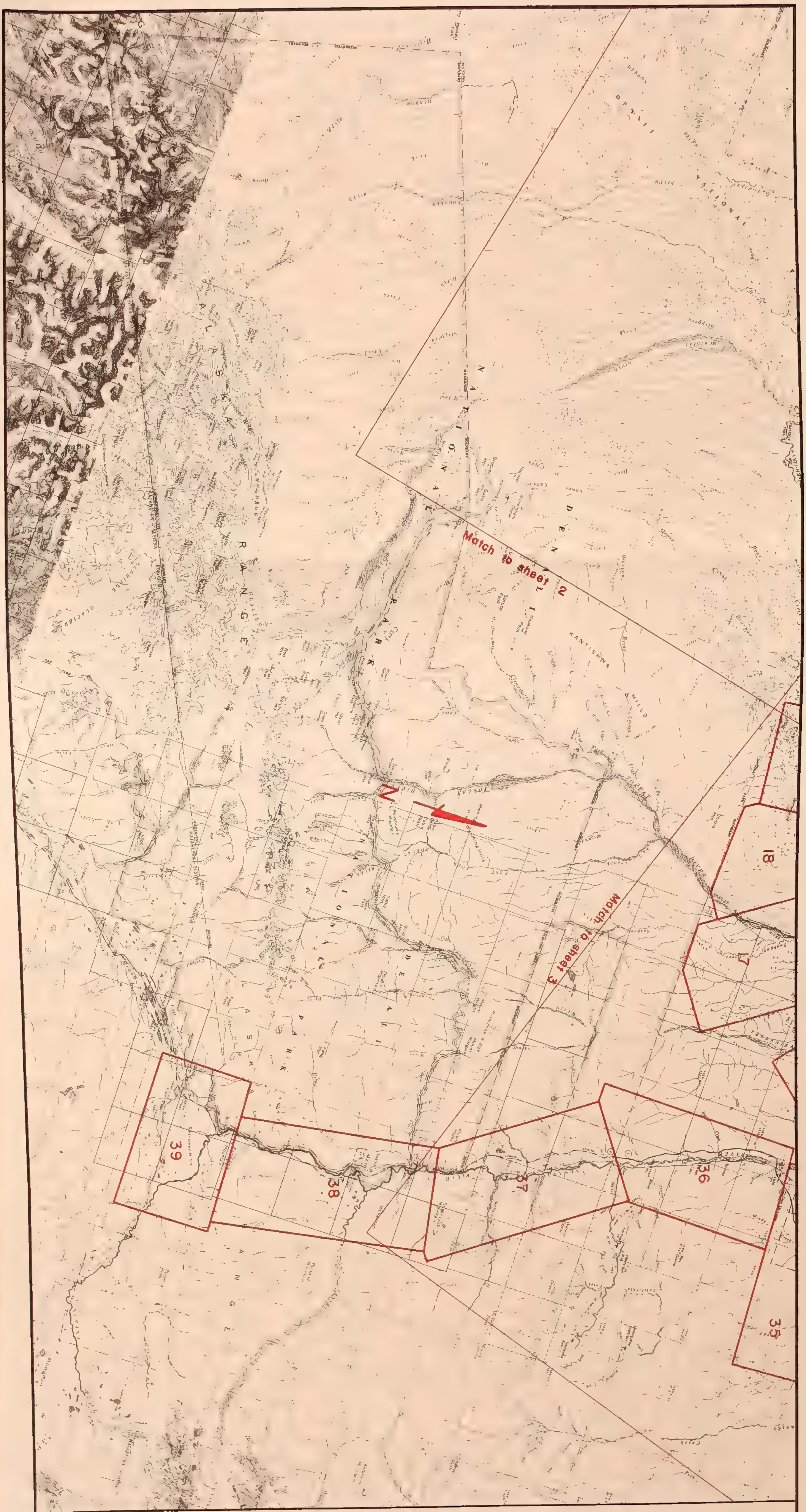
Nenana River Bridge	1,926.0	36,500	49,700	55,000	69,000	1,147	1,527.0
Nenana River Bridge at Healy	2,271.0	40,000	54,500	61,000	76,000	857	1,282.0[1]
Dry Creek Bridge	37.0	1,600	2,600	3,100	4,450	851	1,431.0[1]
Panguingue Creek Bridge	18.0	890	1,530	1,850	2,700	313	1,322.0[1]
Bear Creek Bridge	22.0	1,080	1,820	2,180	3,190	311	837.0[1]
Nenana River Bridge	2,529.0	44,000	60,500	67,000	84,000	216	709.0
Julius Creek Bridge	8.0	460	810	1,000	1,500	317	516.0
Fish Creek Bridge	140.0	4,600	7,100	8,400	11,500	722	414.0
Little Goldstream Bridge	40.0	1,700	2,780	3,300	4,750	678	385.0
Nenana River at Nenana	3,879.0	63,000	85,000	95,000	118,000	—	360.0[1]
Tanana River at Nenana cross-section "D"	25,900.0	116,100	212,000	233,000	285,000	—	360.0[1]



APPENDIX B

EXHIBIT 1.
FLOOD PLAIN MANAGEMENT INDEX MAPS

EXHIBIT 2.
FLOOD PLAIN MANAGEMENT AREA MAPS



LEGEND

2	*Map sheet area coverage*

10 0 10 20 30

SCALE 1:475,000

LOCATION MAP

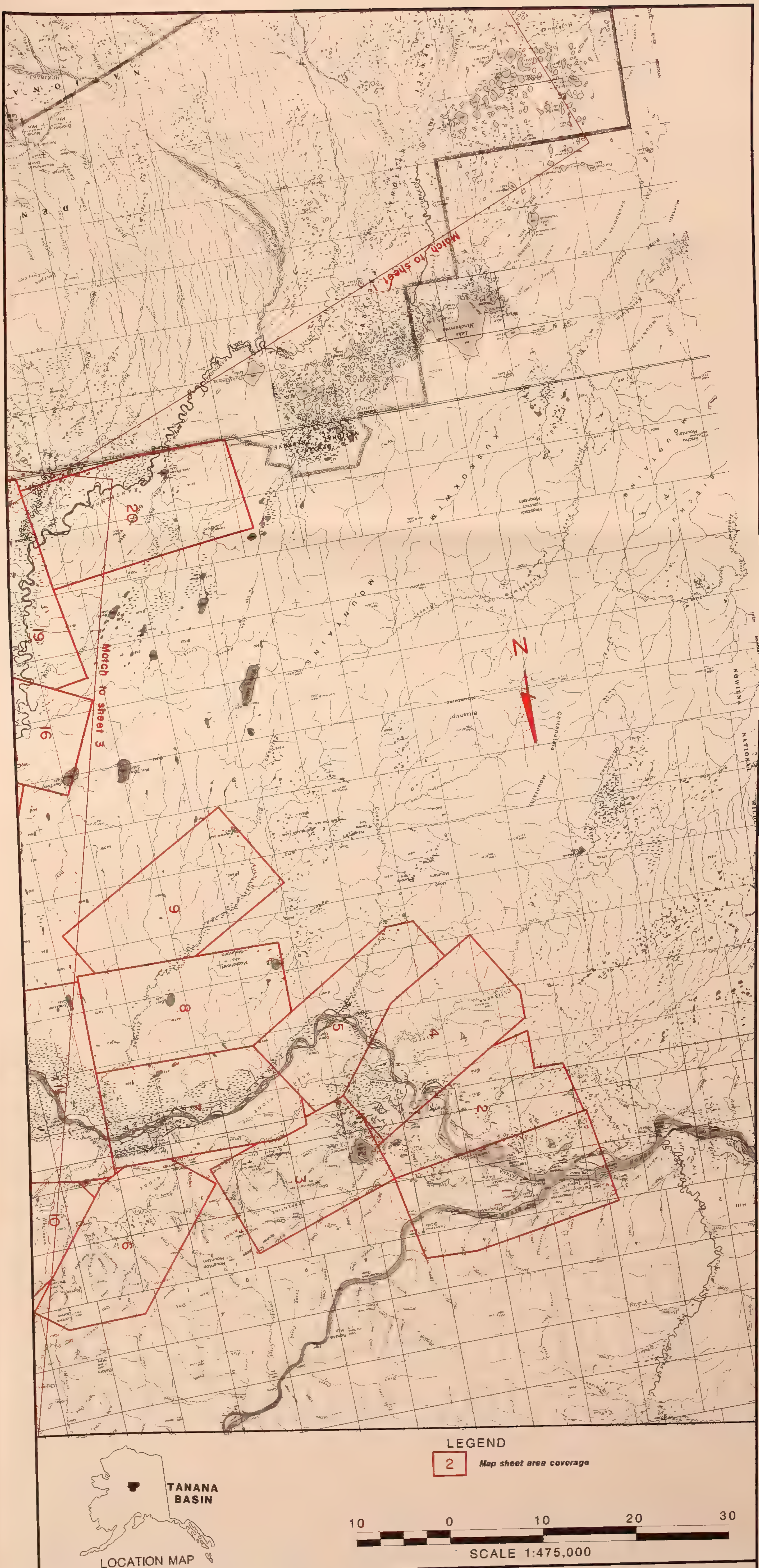
MAP SHEET INDEX

LOWER TANANA RIVER BASIN

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

Sheet 1 of 3

EXHIBIT 1



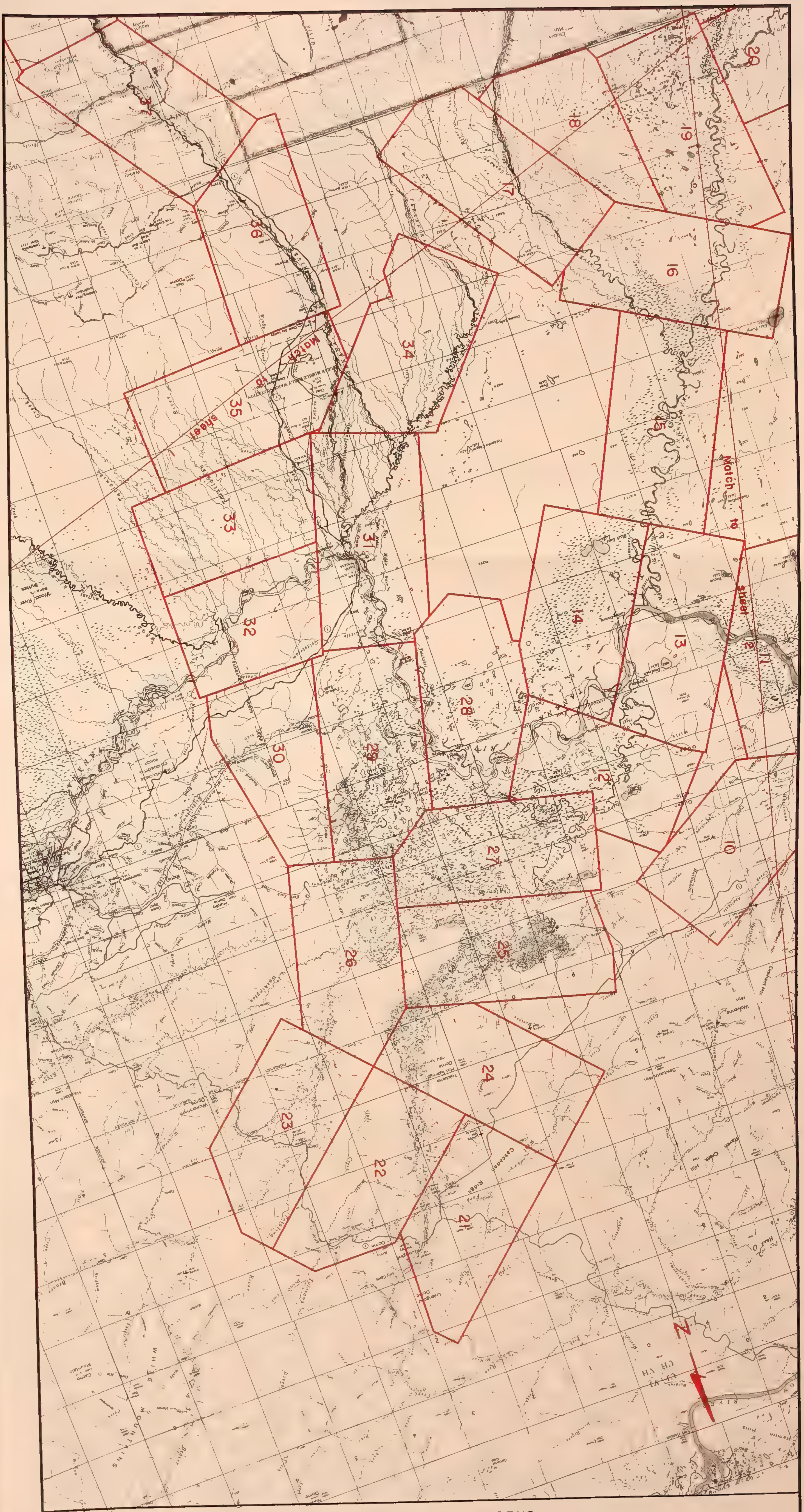
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

MAP SHEET INDEX

LOWER TANANA RIVER BASIN

Sheet 2 of 3

EXHIBIT 1



LEGEND

2 Map sheet area coverage

10 0 10 20 30

SCALE 1:475,000

TANANA BASIN

LOCATION MAP

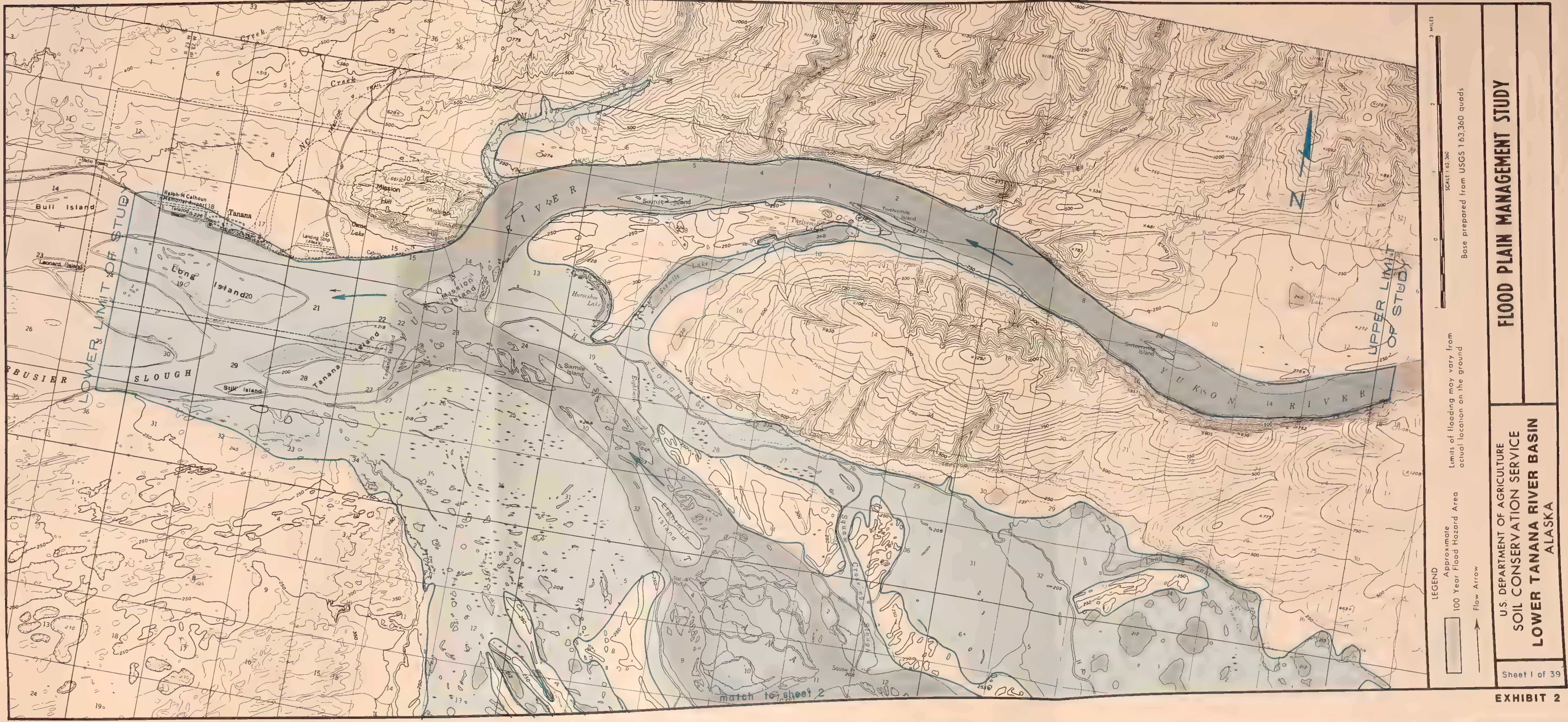
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

MAP SHEET INDEX

LOWER TANANA RIVER BASIN

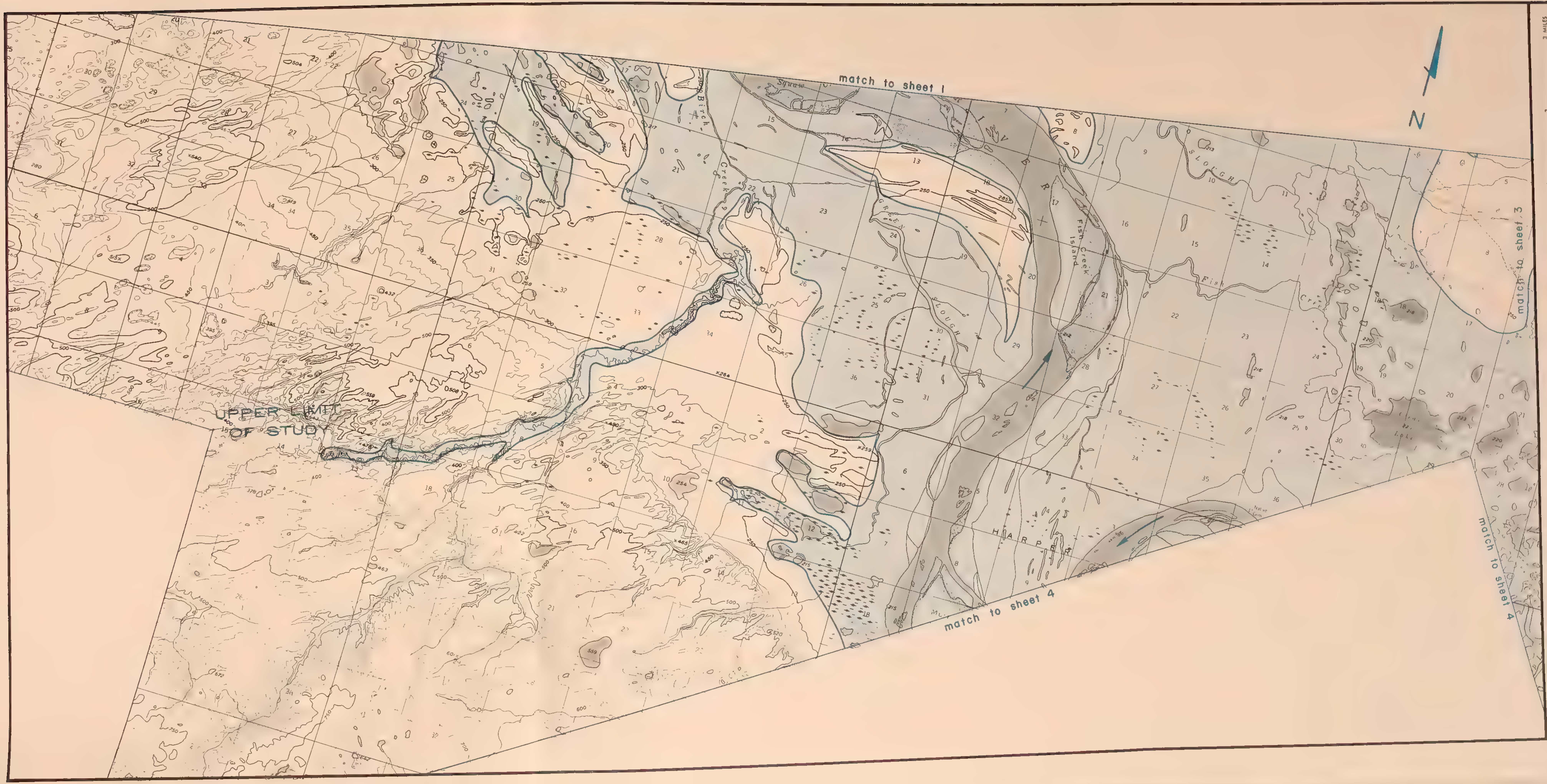
Sheet 3 of 3

EXHIBIT 1



Bull Island
Ralph M Calhoun Memorial Airport
Tanana
Mission Hill
Leonard Island
Long Island
Mission Island
Tanana Island
Still Island
SLOUGH
LOWER LIMIT OF STUDY
UPPER LIMIT OF STUDY
YUKON RIVER
RIVER
Sixmile Island
Twelvemile Island
Sixteenmile Island
Horseshoe Lake
Sixmile Lake
Long Lake
Eightmile Island
Eightmile Slough
Tanana
match to sheet 2
N
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
SCALE 1:63,360
3 MILES
Base prepared from USGS 1:63,360 quads
FLOOD PLAIN MANAGEMENT STUDY
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 1 of 39

EXHIBIT 2



SCALE 1:63,360
0 1 2 MILES

Base prepared from USGS 1:63,360 quads

FLOOD PLAIN MANAGEMENT STUDY

LEGEND

Approximate 100 Year Flood Hazard Area

Limits of flooding may vary from actual location on the ground.

Flow Arrow

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOWER TANANA RIVER BASIN
ALASKA

EXHIBIT 2

LEGEND

Approximate 100 Year Flood Hazard Area

Limits of flooding may vary from actual location on the ground

Flow Arrow

0 1 2 3 MILES

SCALE 1:63 360

Base prepared from USGS 1:63,360 quads

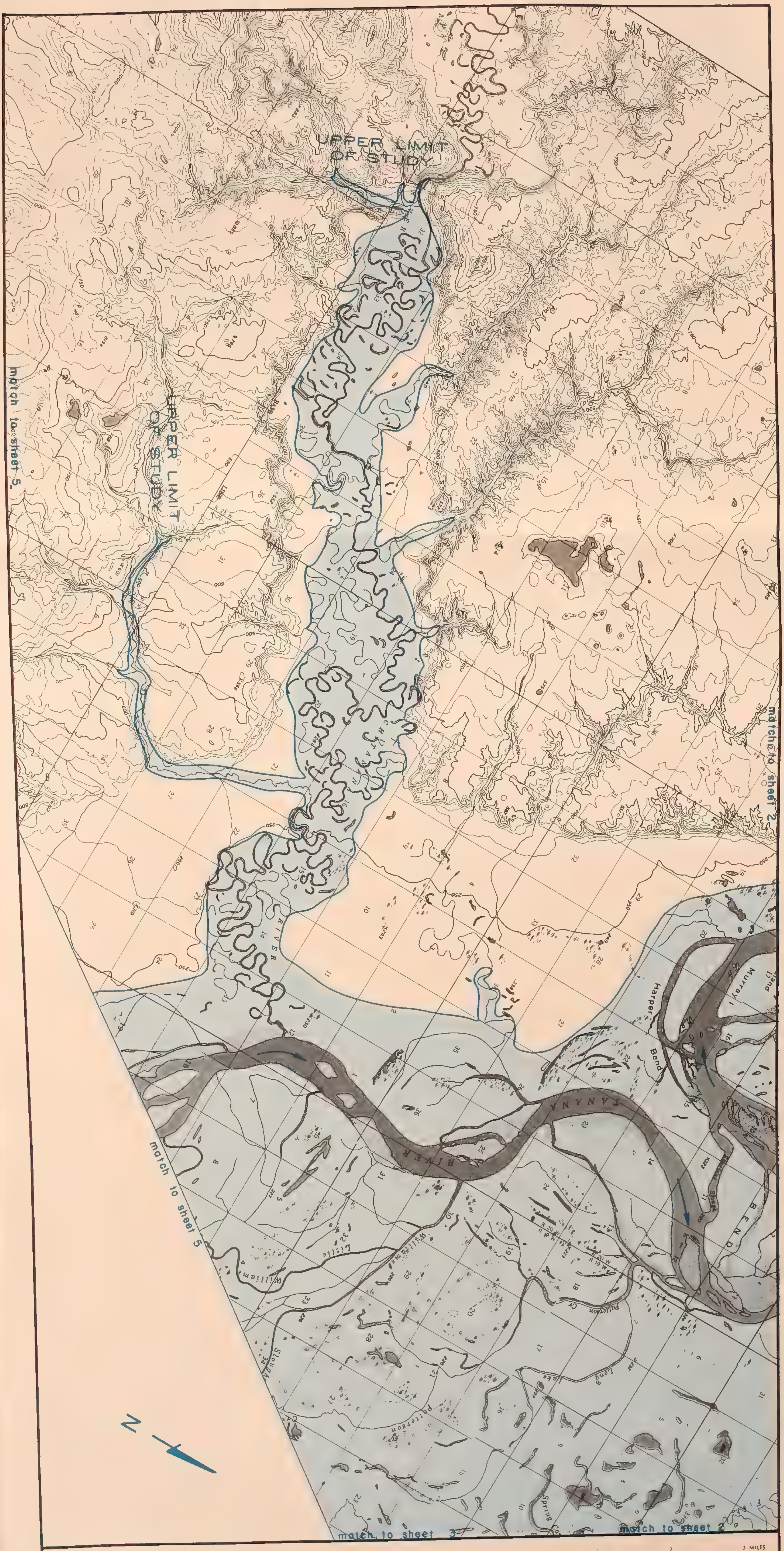
FLOOD PLAIN MANAGEMENT STUDY

FISH LAKE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOWER TANANA RIVER BASIN
ALASKA

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

SCALE 1:63,360

0 1 2 3 MILES

Base prepared from USGS 1:63,360 quads

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

TANANA RIVER / CHITANANA RIVER

Sheet 4 of 39

EXHIBIT 2

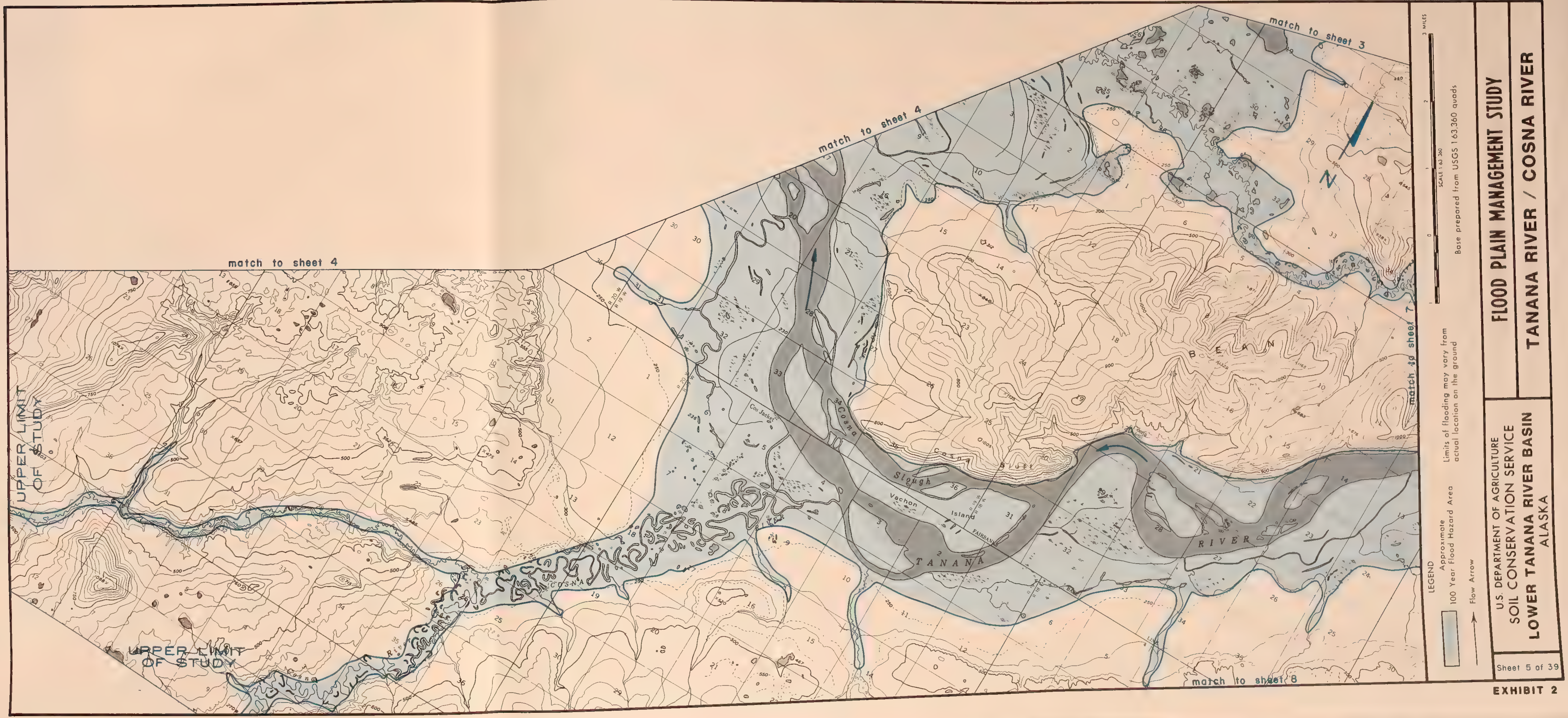
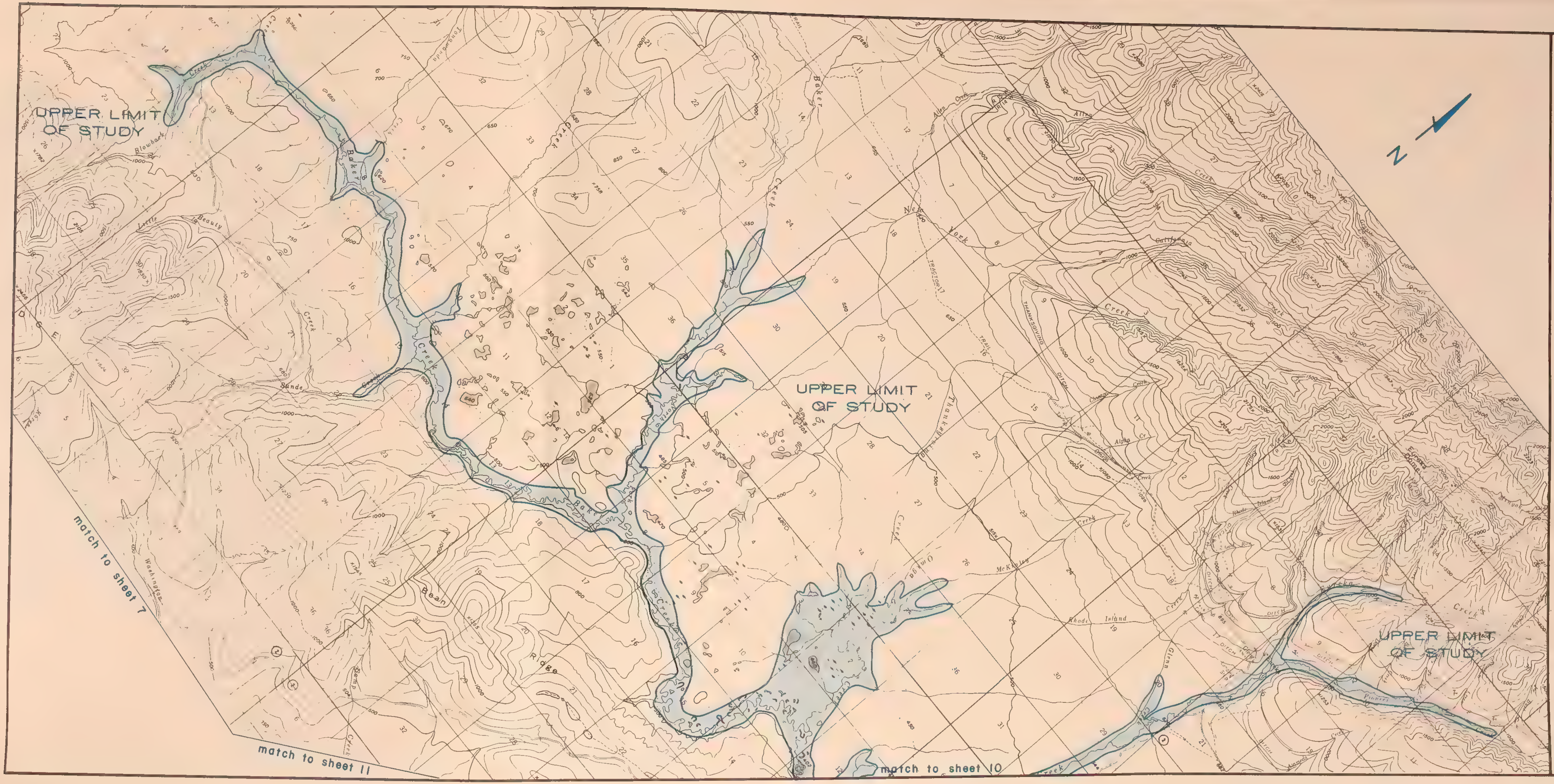

FLOOD PLAIN MANAGEMENT STUDY
TANANA RIVER / COSNA RIVER
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 5 of 39
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
Base prepared from USGS 1:63,360 quads
3 MILES
match to sheet 3
match to sheet 4
match to sheet 4
match to sheet 7
match to sheet 8
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
TANANA RIVER
Cosna Slough
Vachon Island
Cosna
BEAN
N

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

Base prepared from USGS 1:63 360 quads

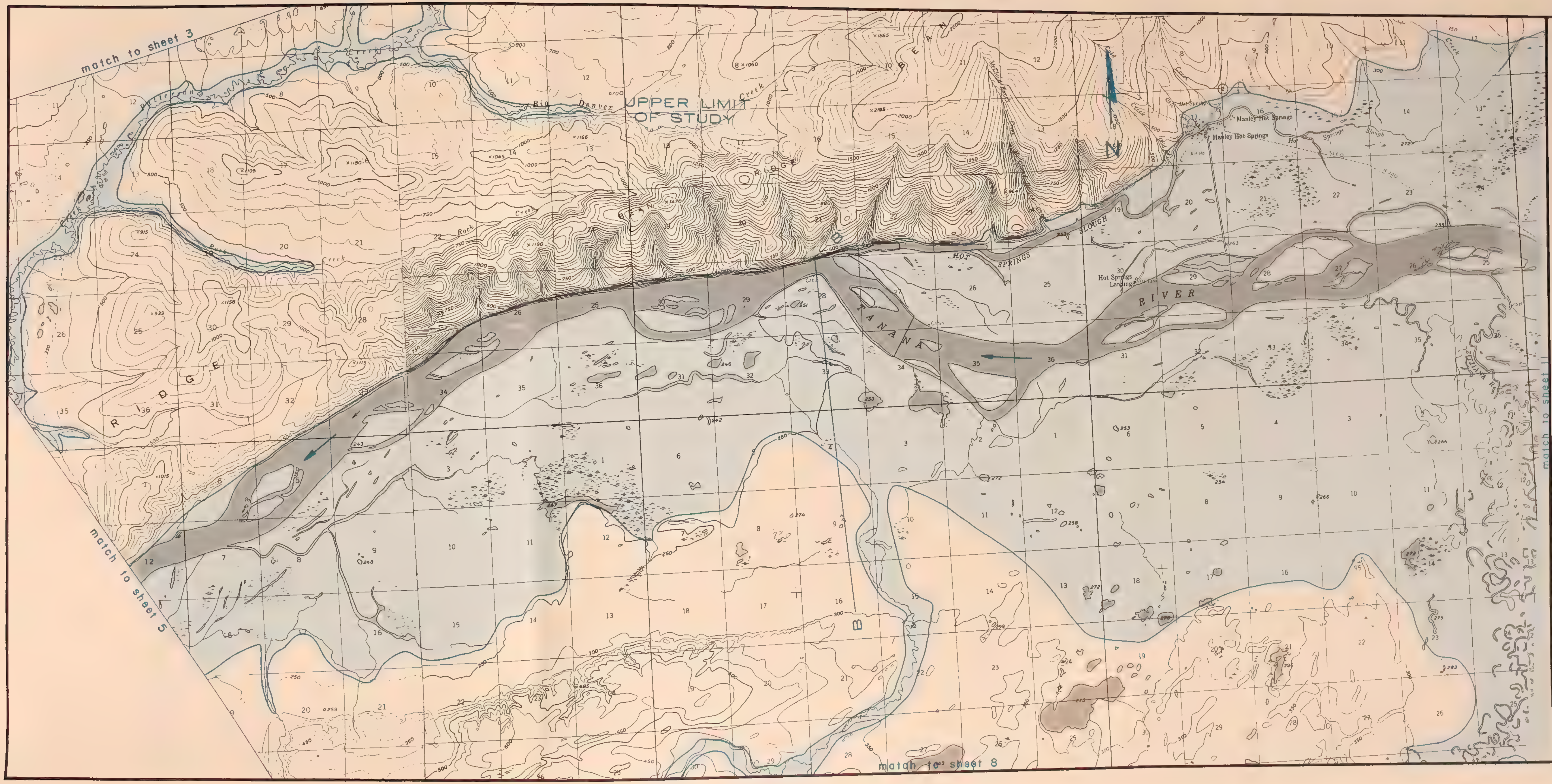
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

BAKER CREEK

Sheet 6 of 39

EXHIBIT 2



FLOOD PLAIN MANAGEMENT STUDY

Base prepared from USGS 1:63,360 quads.

Limits of flooding may vary from actual location on the ground.

LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Valley Section

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOWER TANANA RIVER BASIN
ALASKA

Sheet 7 of 39

EXHIBIT 2

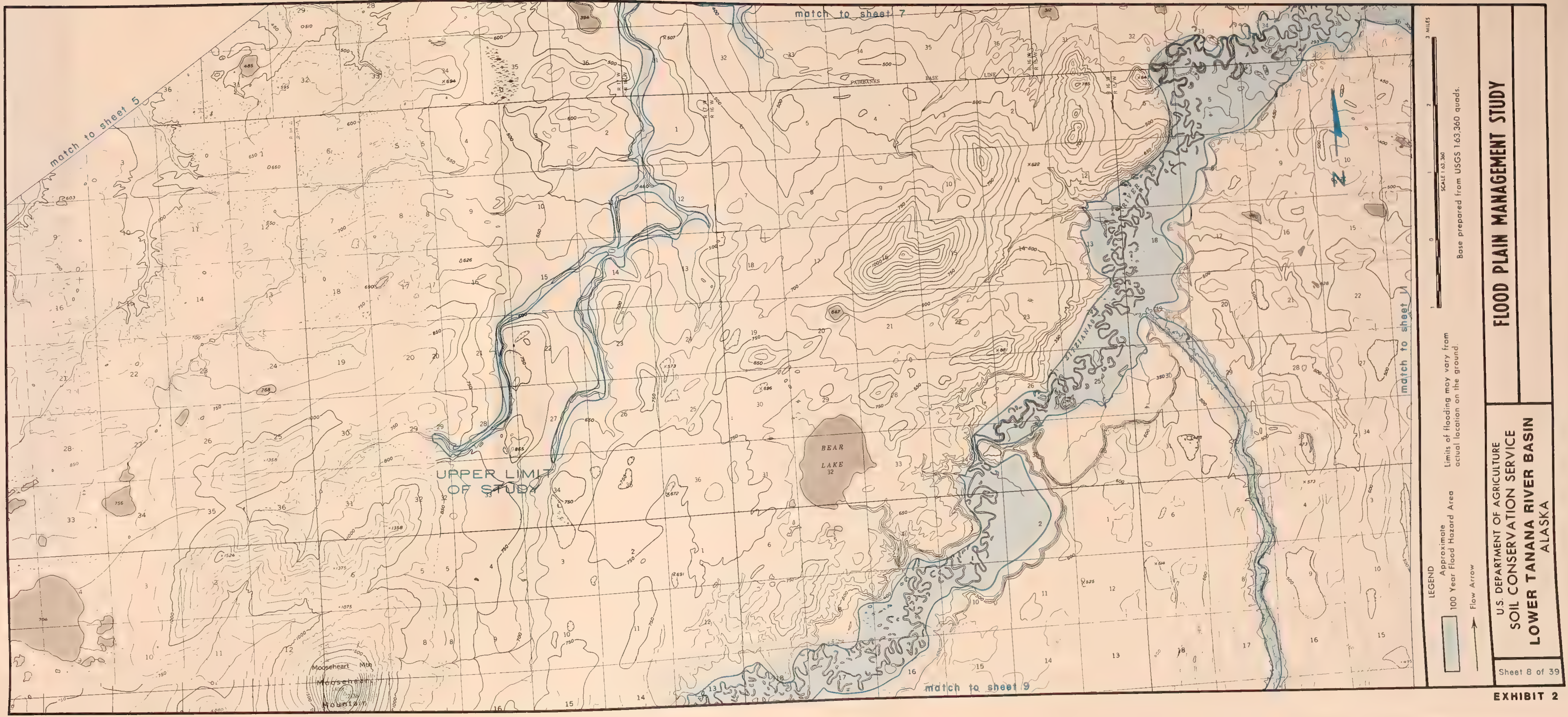

match to sheet 7
match to sheet 5
match to sheet 11
match to sheet 9
FAIRBANKS
BASE
LINE
UPPER LIMIT
OF STUDY
BEAR
LAKE
Moosehear Mtn
LEGEND
Approximate
100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground.
Base prepared from USGS 1:63,360 quads.
3 MILES
FLOOD PLAIN MANAGEMENT STUDY
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 8 of 39

EXHIBIT 2

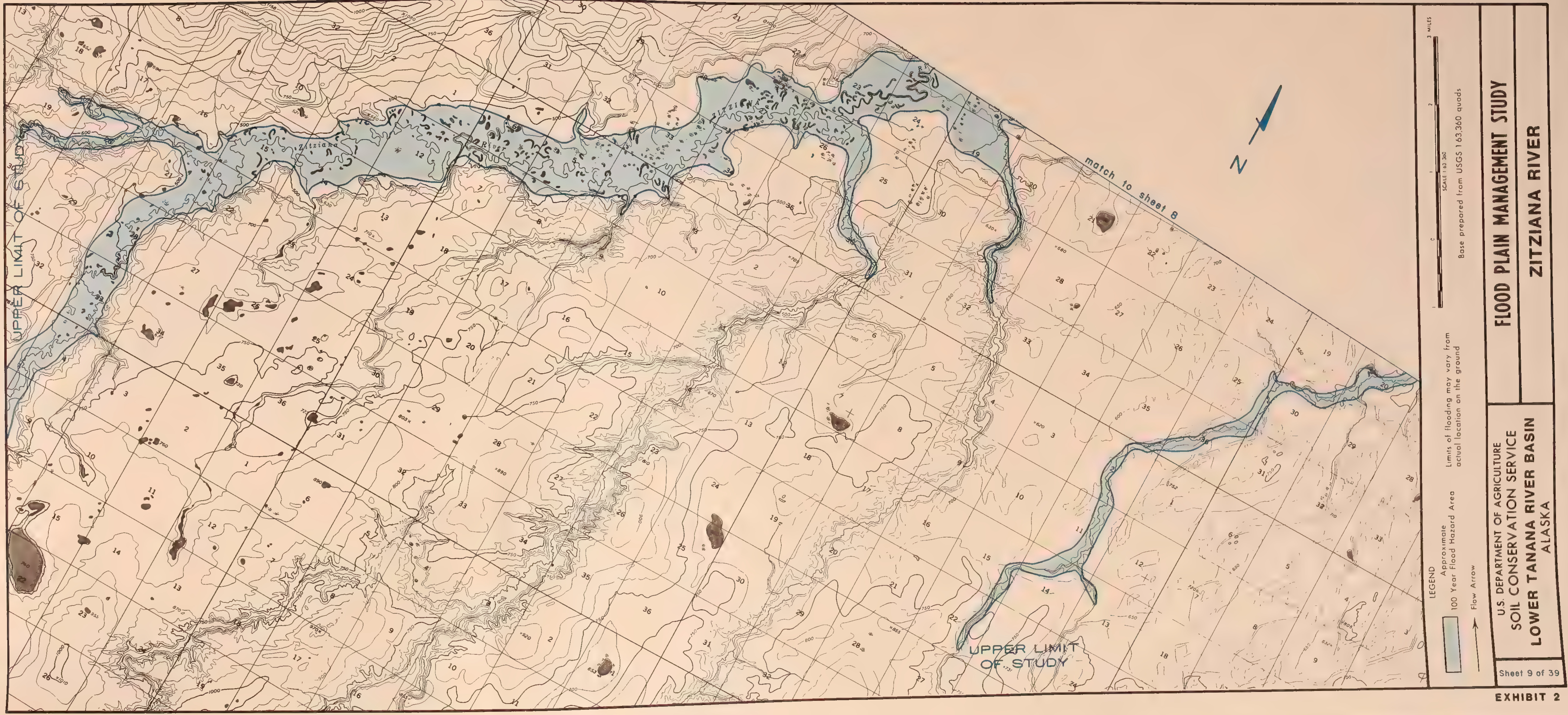
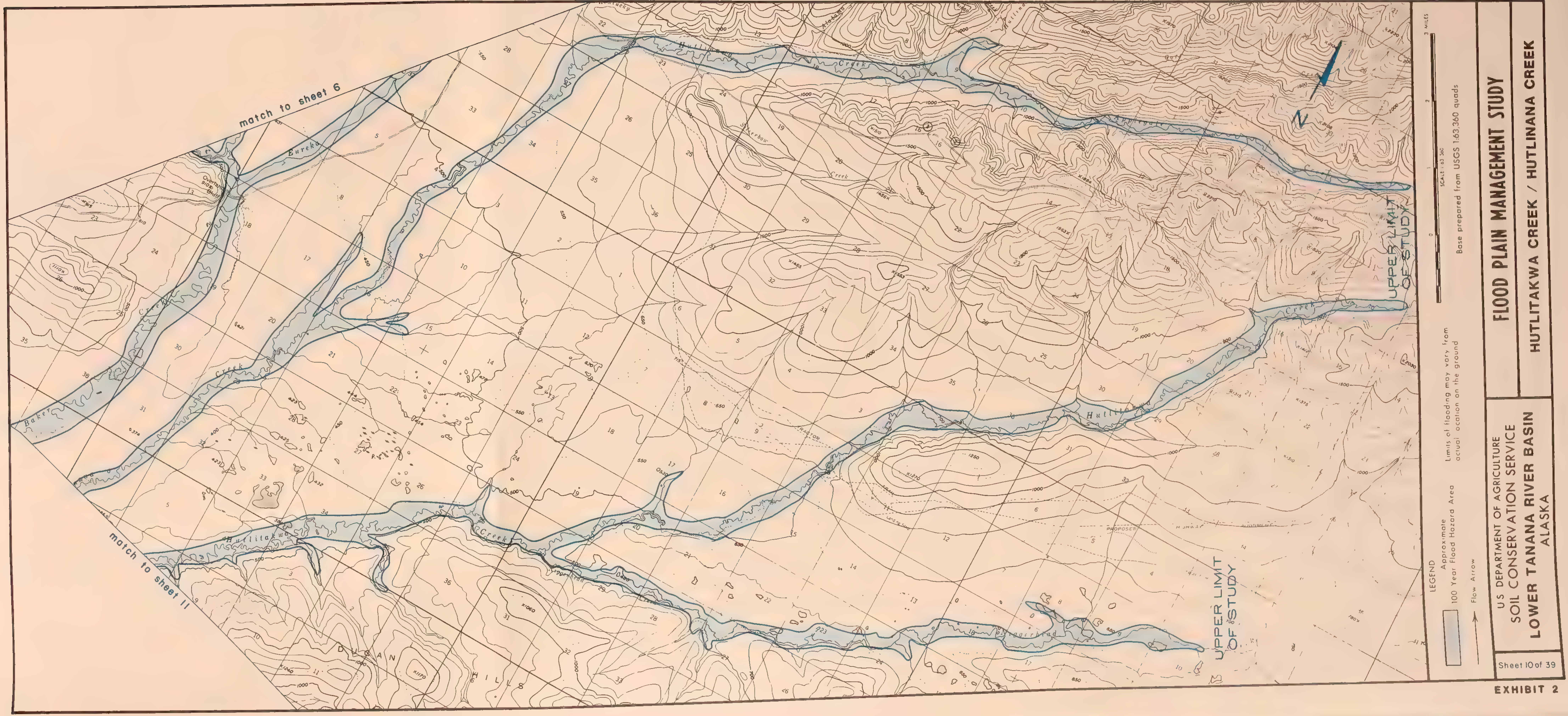
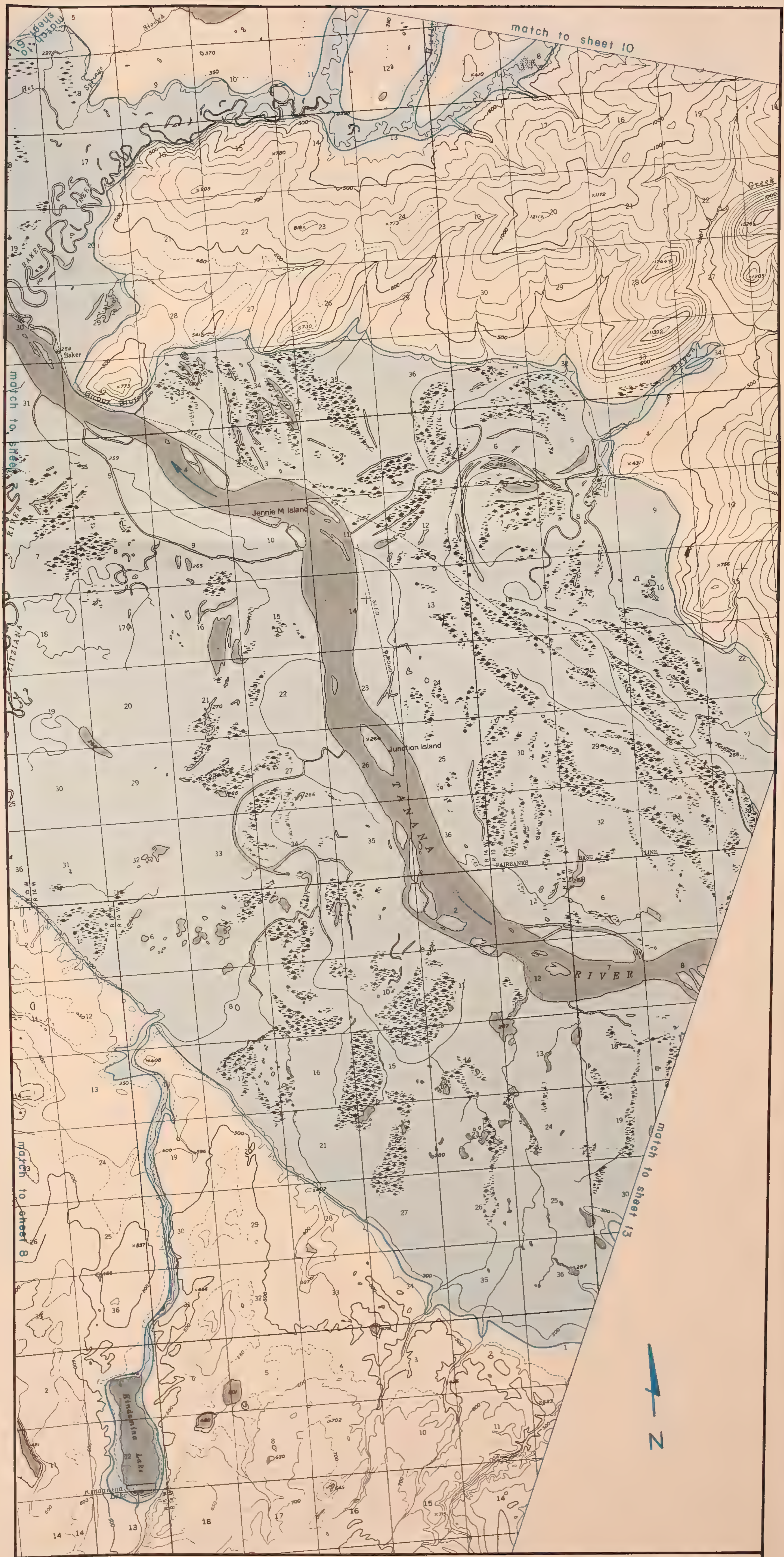

UPPER LIMIT OF STUDY
Zitziana River
match to sheet 8
UPPER LIMIT OF STUDY
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
Base prepared from USGS 1:63,360 quads
FLOOD PLAIN MANAGEMENT STUDY
ZITZIANA RIVER
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 9 of 39

EXHIBIT 2



match to sheet 6
match to sheet 11
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
Hutlitakwa Creek
Hutlinana Creek
Eureka Creek
Baker Creek
Fingerhead Creek
DUGAN HILLS
LEGEND
100 Year Approximate Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
SCALE 1:63 360
0 1 2 3 MILES
Base prepared from USGS 1:63,360 quads
FLOOD PLAIN MANAGEMENT STUDY
HUTLITAKWA CREEK / HUTLINANA CREEK
US DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 10 of 39

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground.

SCALE 1:63,360

0 1 2 3 MILES

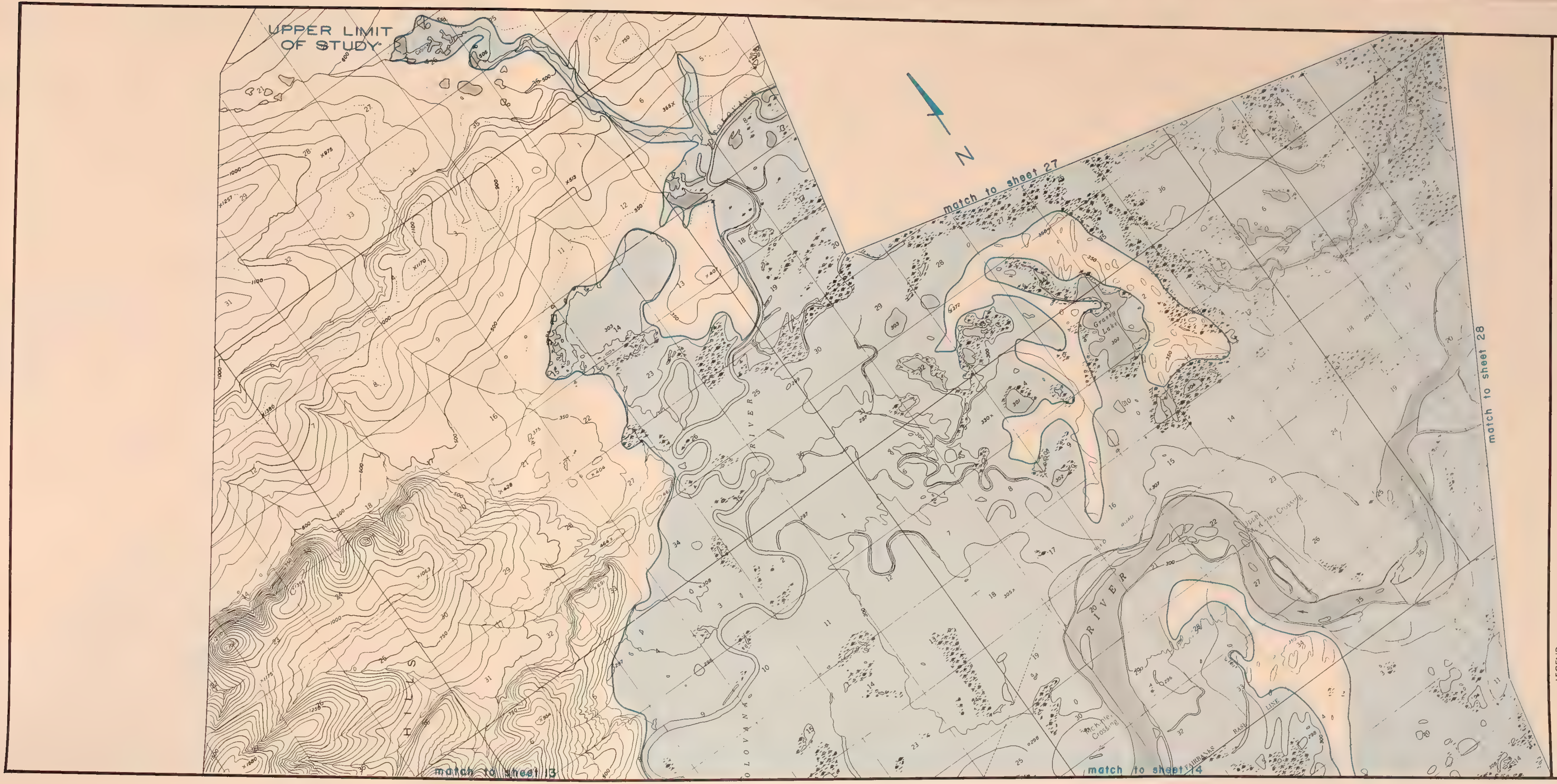
Base prepared from USGS 1:63,360 quads.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

TANANA RIVER / KINDANINA LAKE

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

SCALE 1:63,360

0 1 2 3 MILES

Base prepared from USGS 1:63,360 quads

FLOOD PLAIN MANAGEMENT STUDY

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOWER TANANA RIVER BASIN
ALASKA

Sheet 12 of 39

EXHIBIT 2

LEGEND

Approximate 100 Year Flood Hazard Area

Limits of flooding may vary from actual location on the ground

Flow Arrow

Valley Section

0 1 2 3 MILES

SCALE 1:63 360

Base prepared from USGS 1:63,360 quads

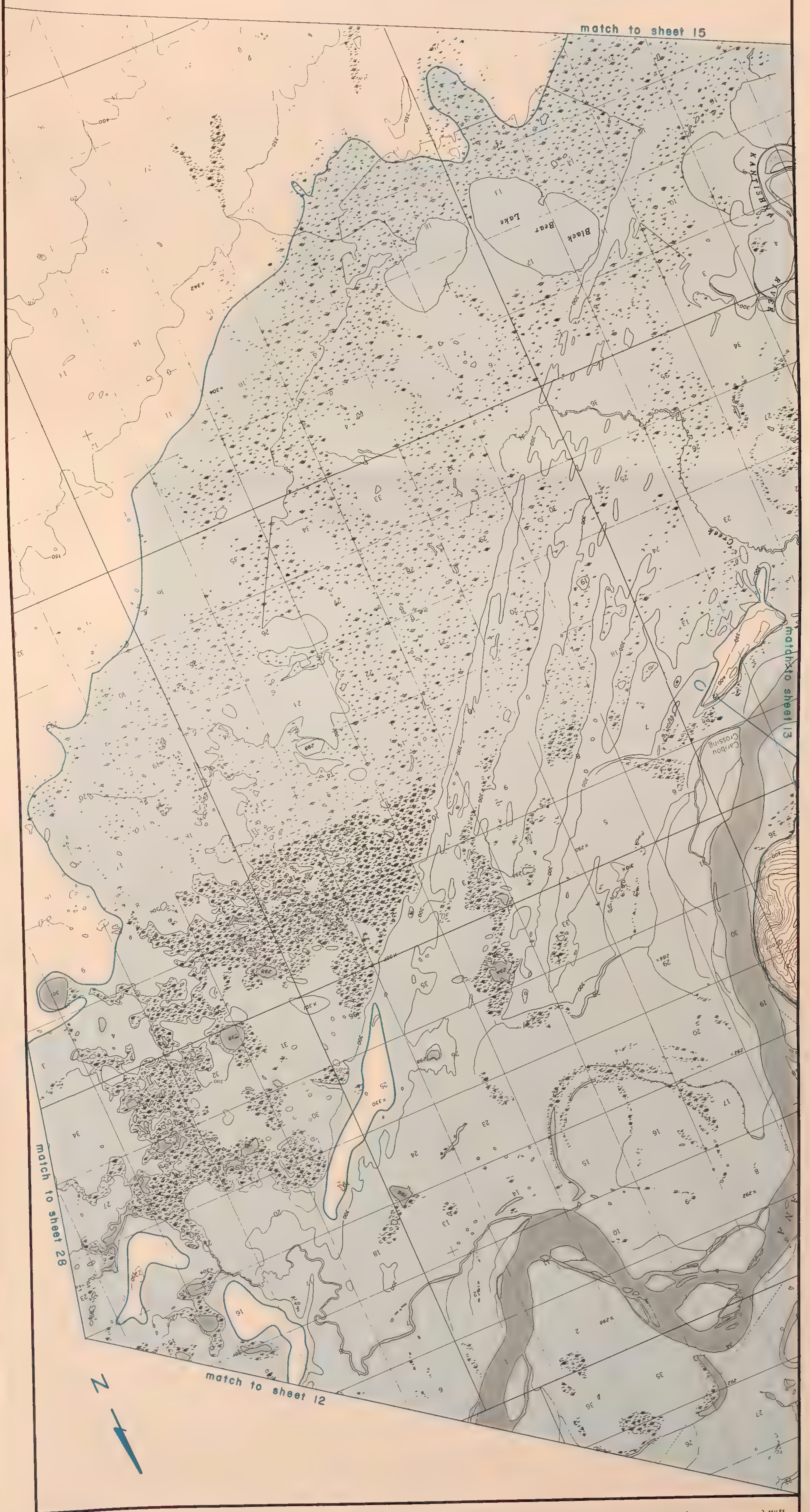
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

TANANA RIVER / DEADMAN LAKE

Sheet 13 of 39

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Valley Section

Limits of flooding may vary from actual location on the ground.

SCALE 1:63,360

1 0 1 2 3 MILES

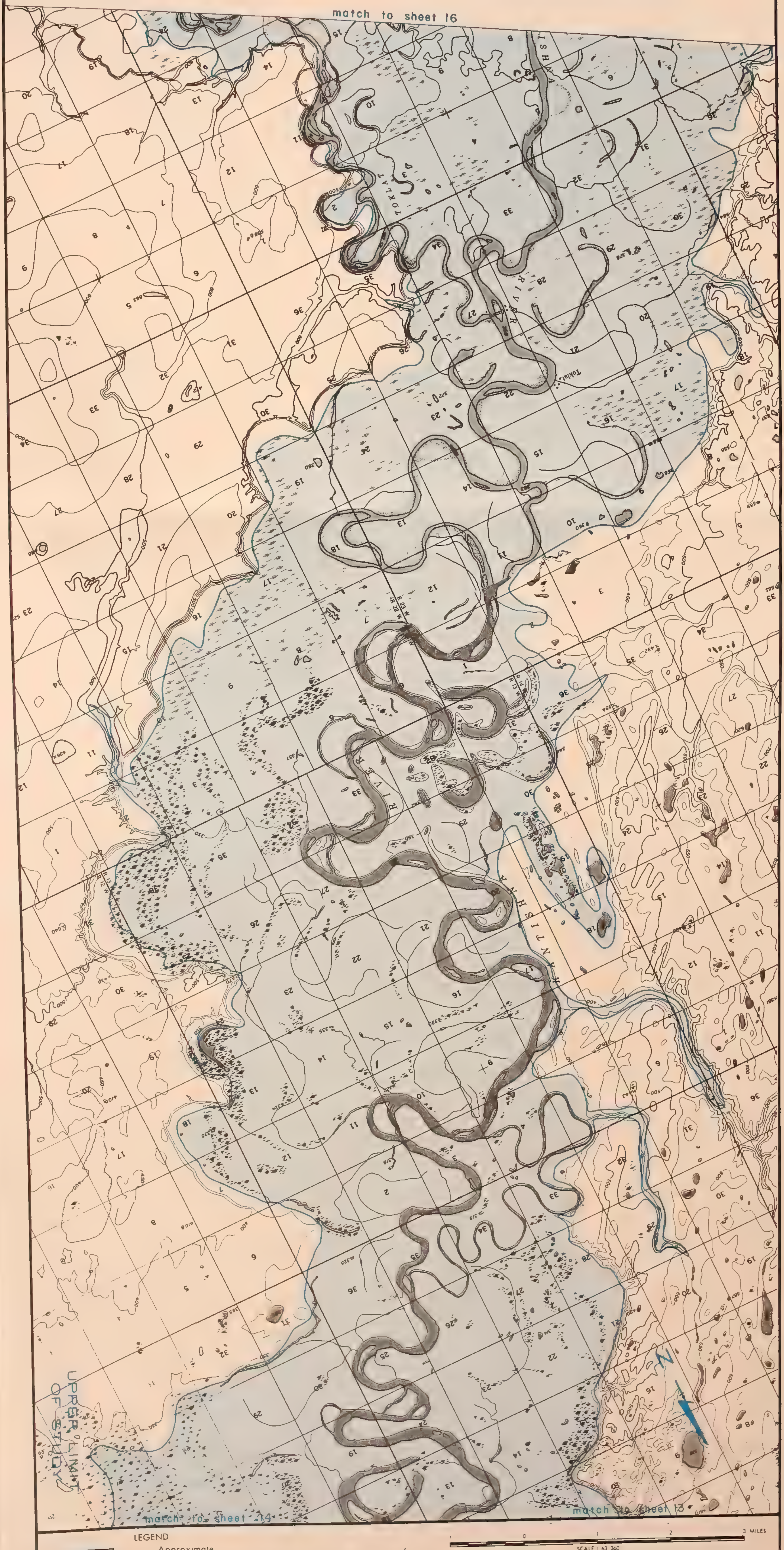
Base prepared from USGS 1:63,360 quads

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

Sheet 14 of 39

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Limits of flooding may vary from actual location on the ground

Flow Arrow

0 1 2 3 MILES

SCALE 1:63,360

Base prepared from USGS 1:63,360 quads

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

KANTISHNA RIVER / TOKLAT RIVER

Sheet 15 of 39

EXHIBIT 2

LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

SCALE 1:63,360

0 1 2 3 MILES

Base prepared from USGS 1:63,360 quads

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

KANTISHNA RIVER / TOKLAT RIVER

Sheet 16 of 39

EXHIBIT 2

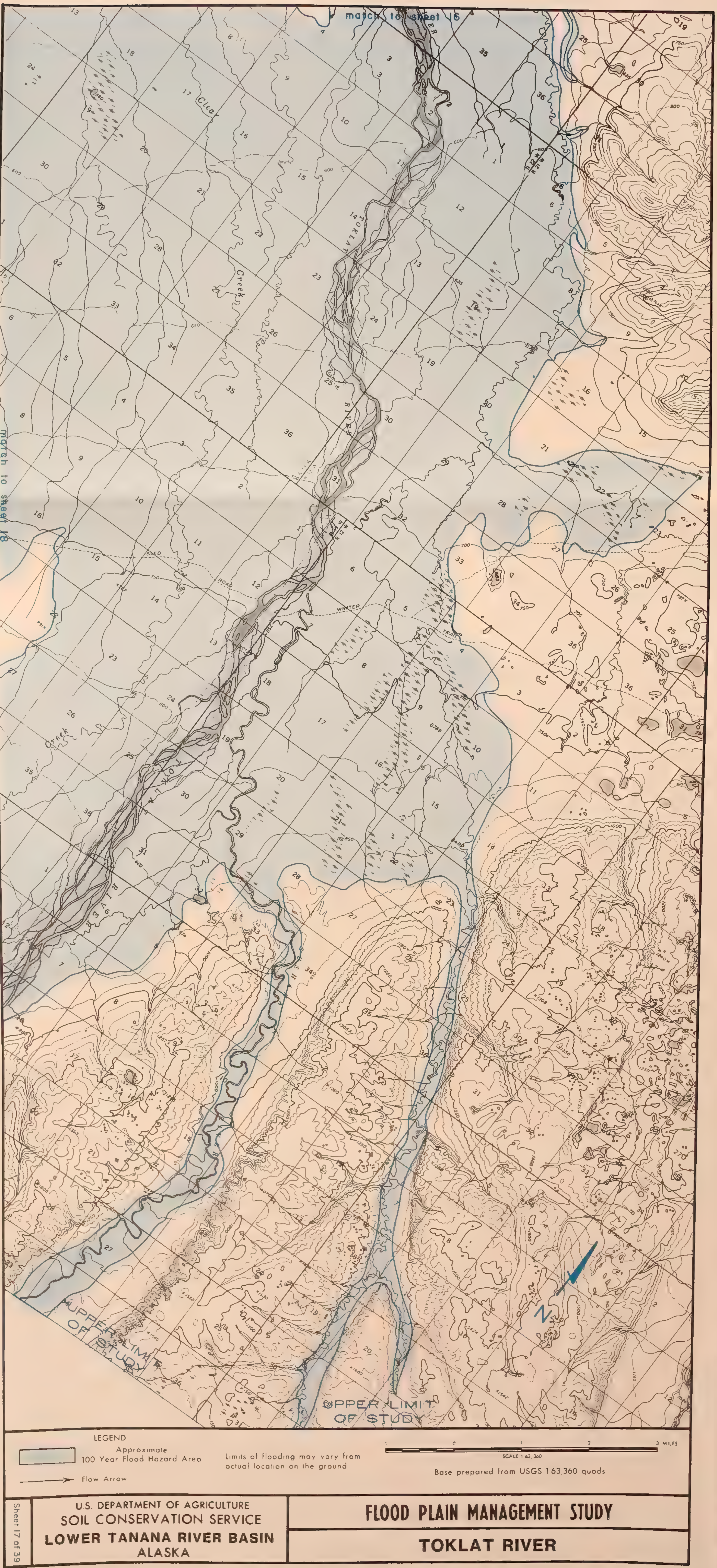
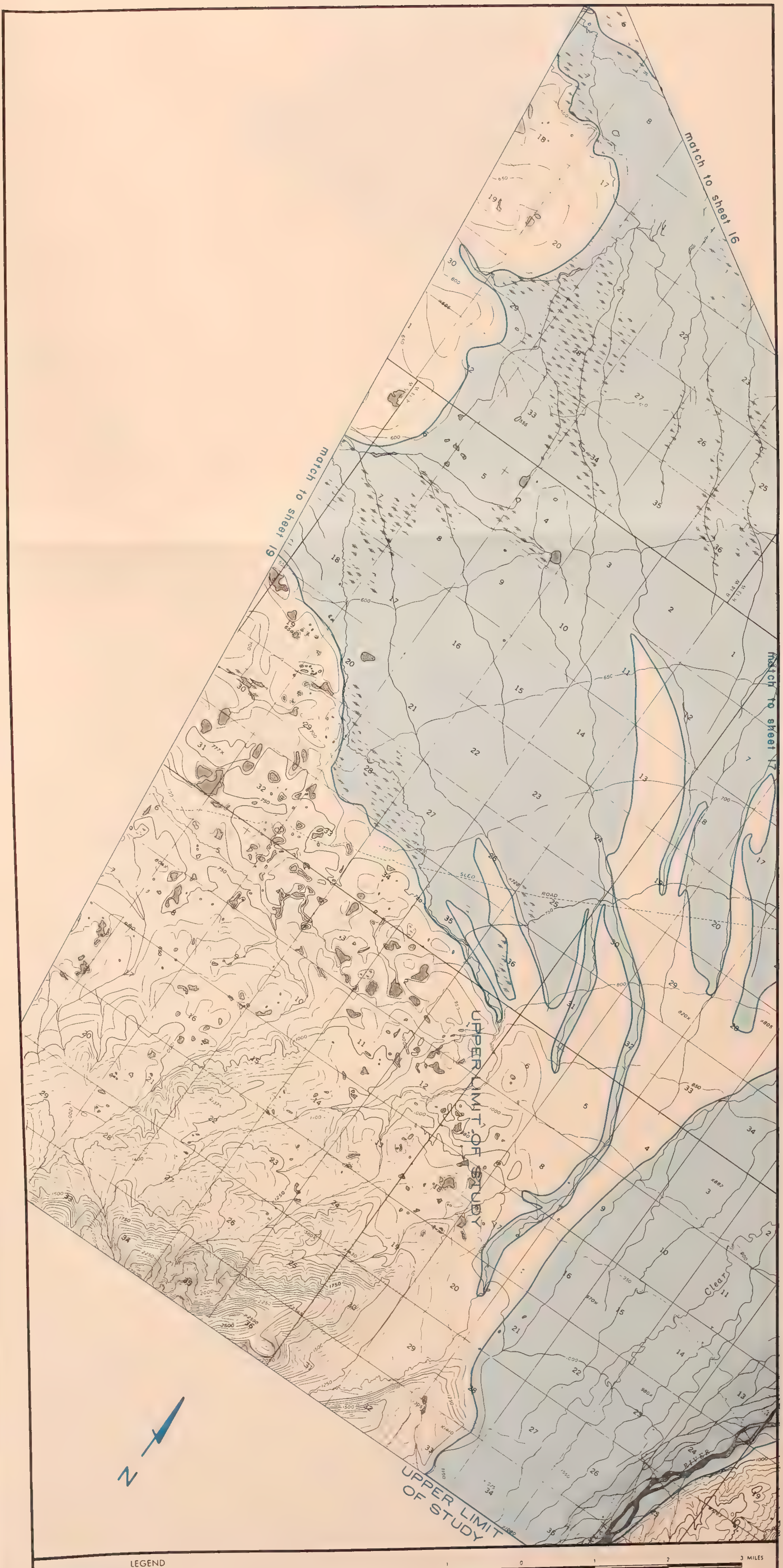

match to sheet 16
match to sheet 18
TOKLAT RIVER
Clear Creek
WINTER TRAIL
SLED ROAD
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
N
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
SCALE 1:63,360
3 MILES
Base prepared from USGS 1:63,360 quads
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
FLOOD PLAIN MANAGEMENT STUDY
TOKLAT RIVER
Sheet 17 of 39

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground.

0 1 2 3 MILES

SCALE 1:63,360

Base prepared from USGS 1:63,360 quads.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

KANTISHNA RIVER DRAINAGE AREA

Sheet 18 of 39

EXHIBIT 2

LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground.

SCALE 1:63,360

1 0 1 2 3 MILES

Base prepared from USGS 1:63,360 quads

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

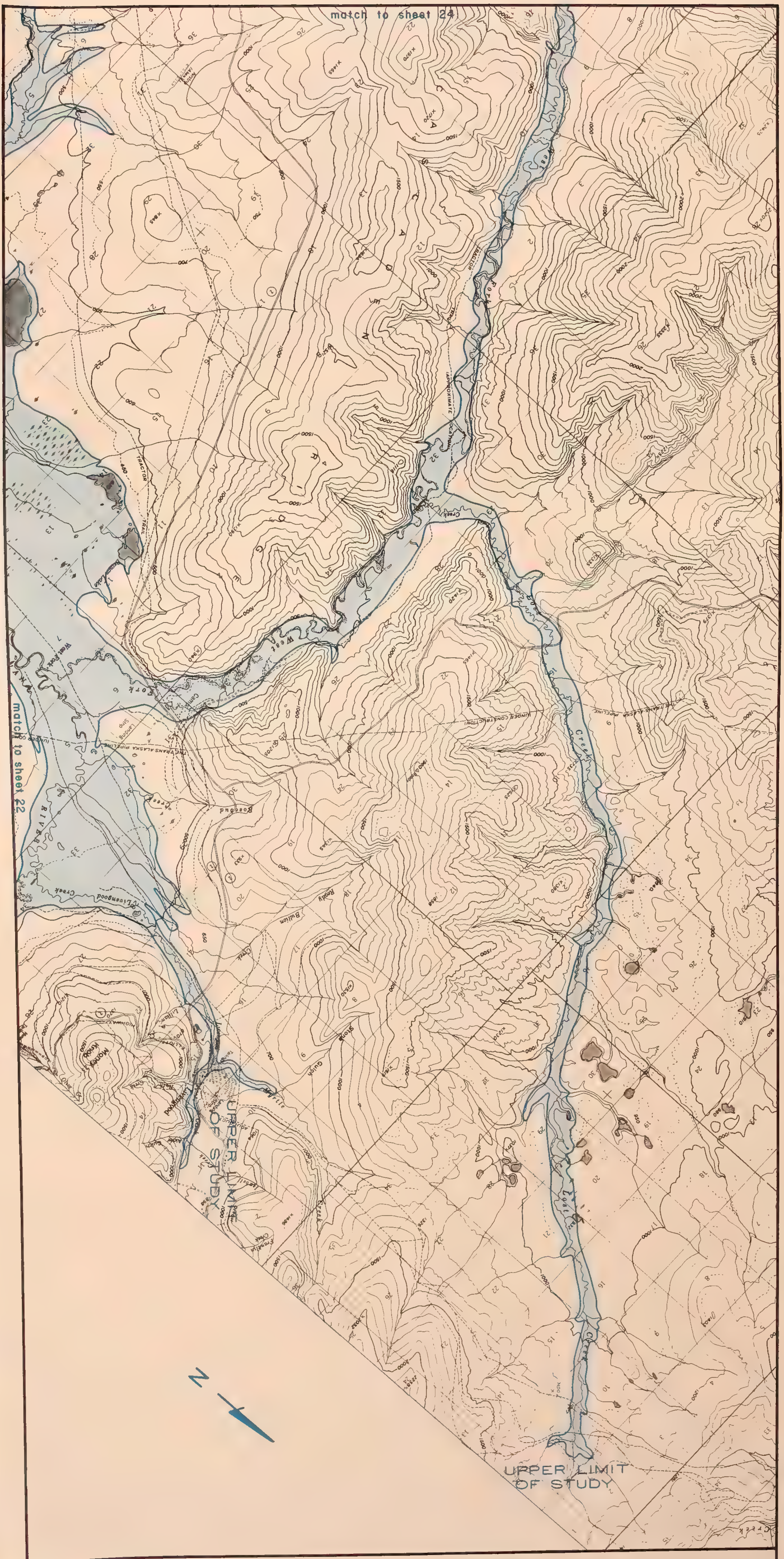
KANTISHNA RIVER

Sheet 19 of 39

EXHIBIT 2


UPPER LIMIT OF STUDY
FLOOD PLAIN MANAGEMENT STUDY
KANTISHNA RIVER
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 20 of 39
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
Base prepared from USGS 1:63,360 quads
John Hansen Lake
Jeannes Lake
John Hansen Creek
KANTISHNA
RIVER
match to sheet 19
N

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

SCALE 1:63,360

1 0 1 2 3 MILES

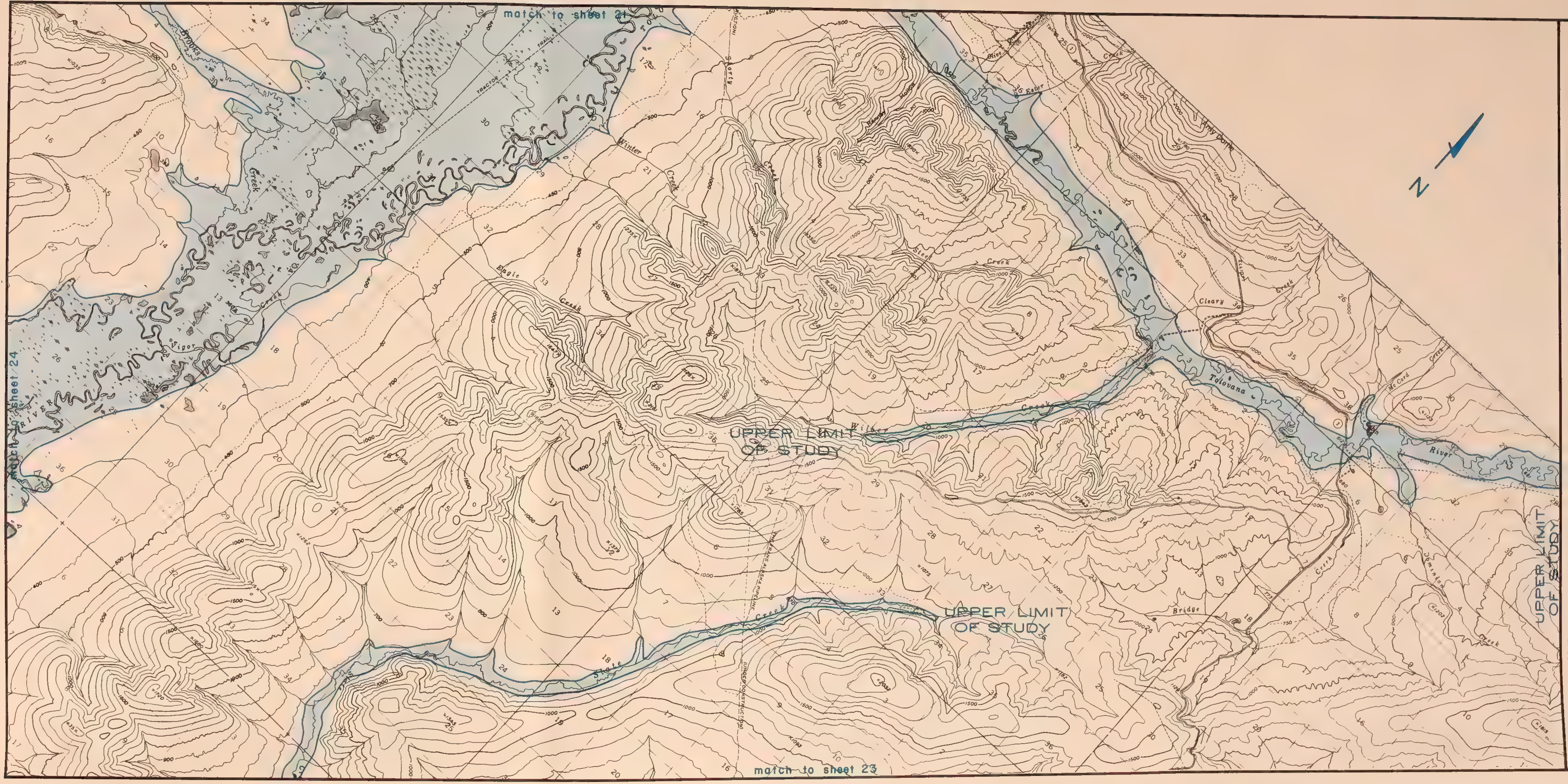
Base prepared from USGS 1:63,360 quads

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

WEST FORK TOLOVANA RIVER / LIVENGOOD

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

SCALE 1:63,360

0 1 2 3 MILES

Base prepared from USGS 1:63,360 quads

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

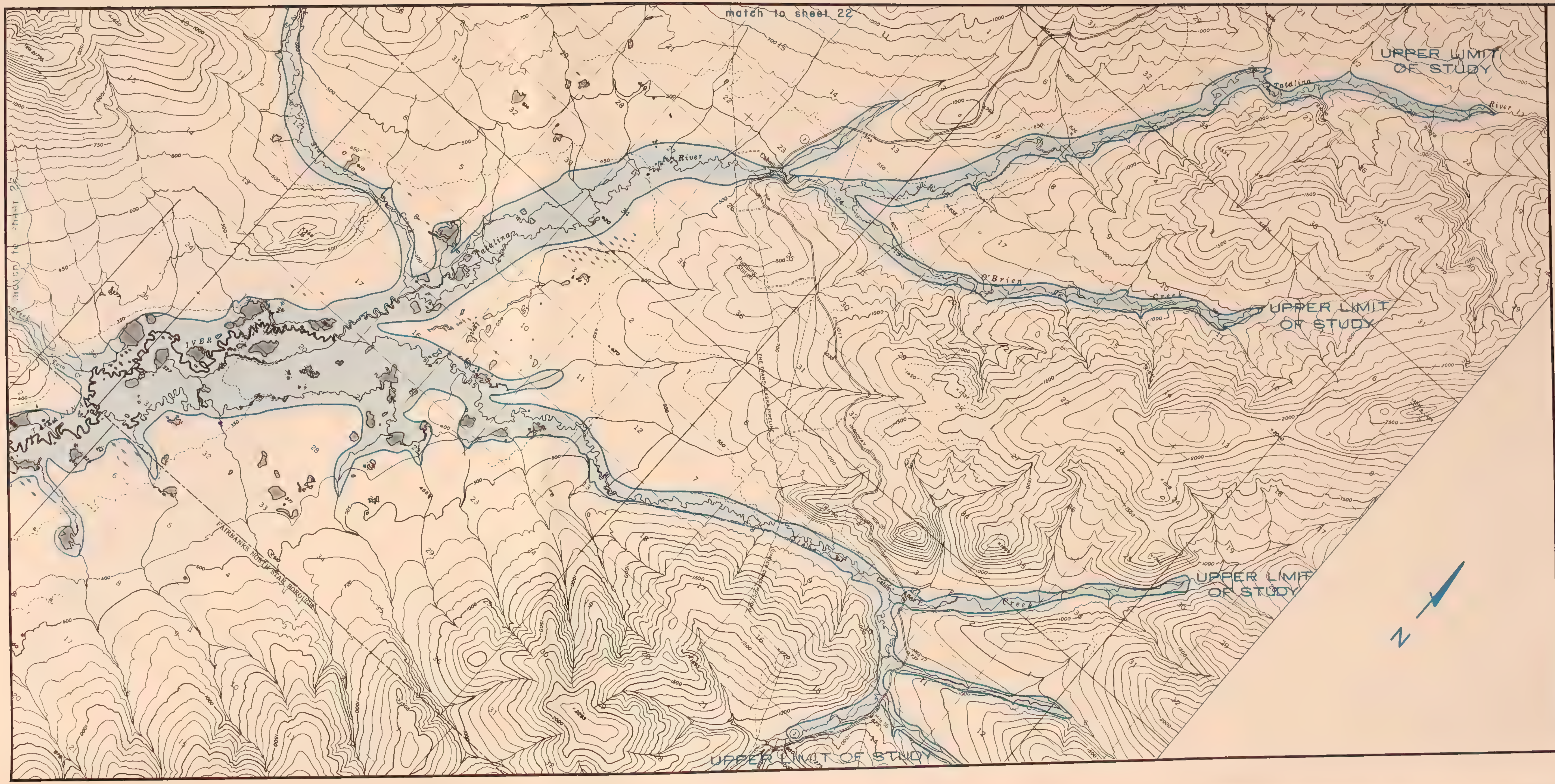
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

TOLOVANA RIVER

Sheet 22 of 39

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

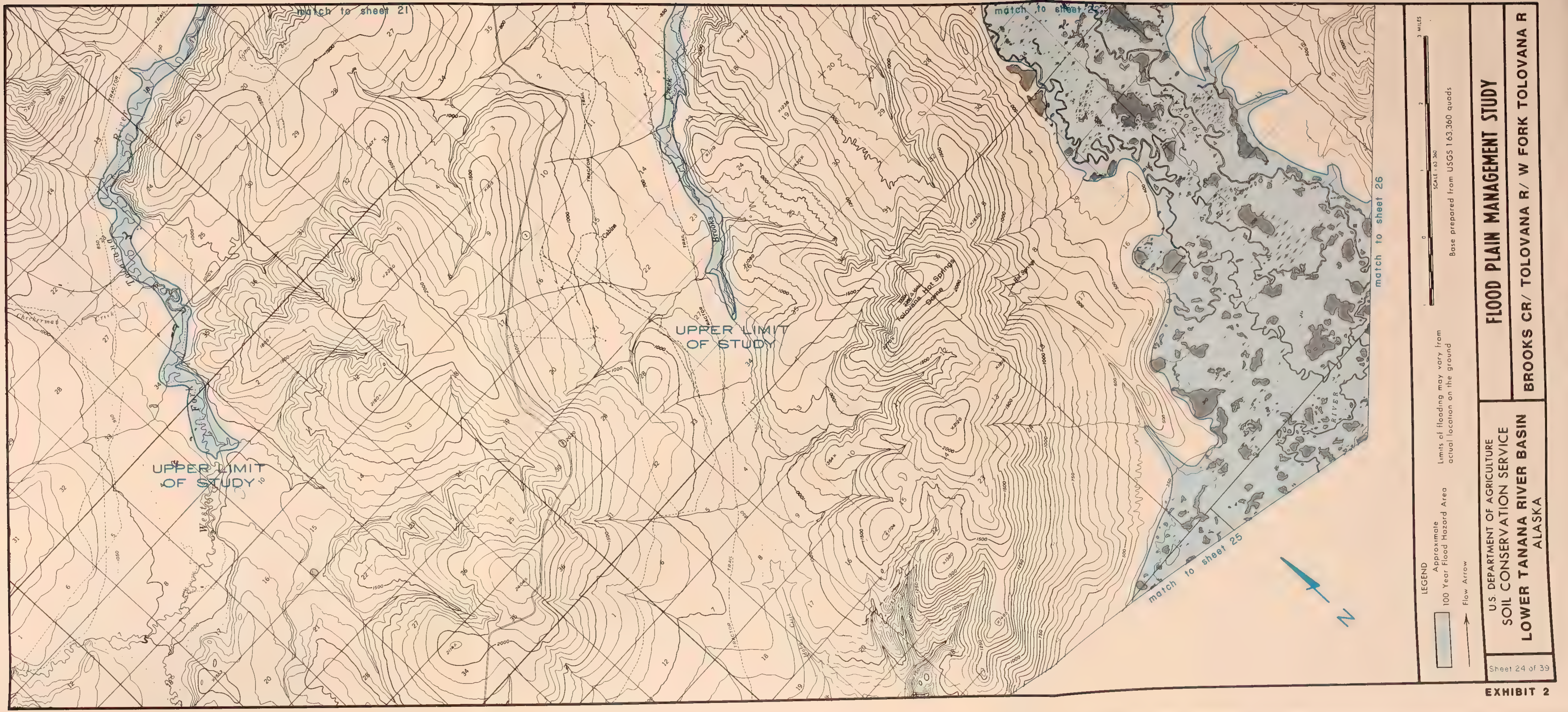
Base prepared from USGS 1:63,360 quads

FLOOD PLAIN MANAGEMENT STUDY

TATALINA RIVER / GLOBE CREEK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

EXHIBIT 2



match to sheet 21
match to sheet 22
match to sheet 26
match to sheet 25
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
Tolovana Hot Springs Dome
Brooks
Creek
Tolovana
River
Chatterman Creek
Cabins
TRACTOR
TRAIL
N
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
SCALE 1:63 360
0 1 2 3 MILES
Base prepared from USGS 1:63,360 quads
FLOOD PLAIN MANAGEMENT STUDY
BROOKS CR/ TOLOVANA R/ W FORK TOLOVANA R
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 24 of 39

EXHIBIT 2

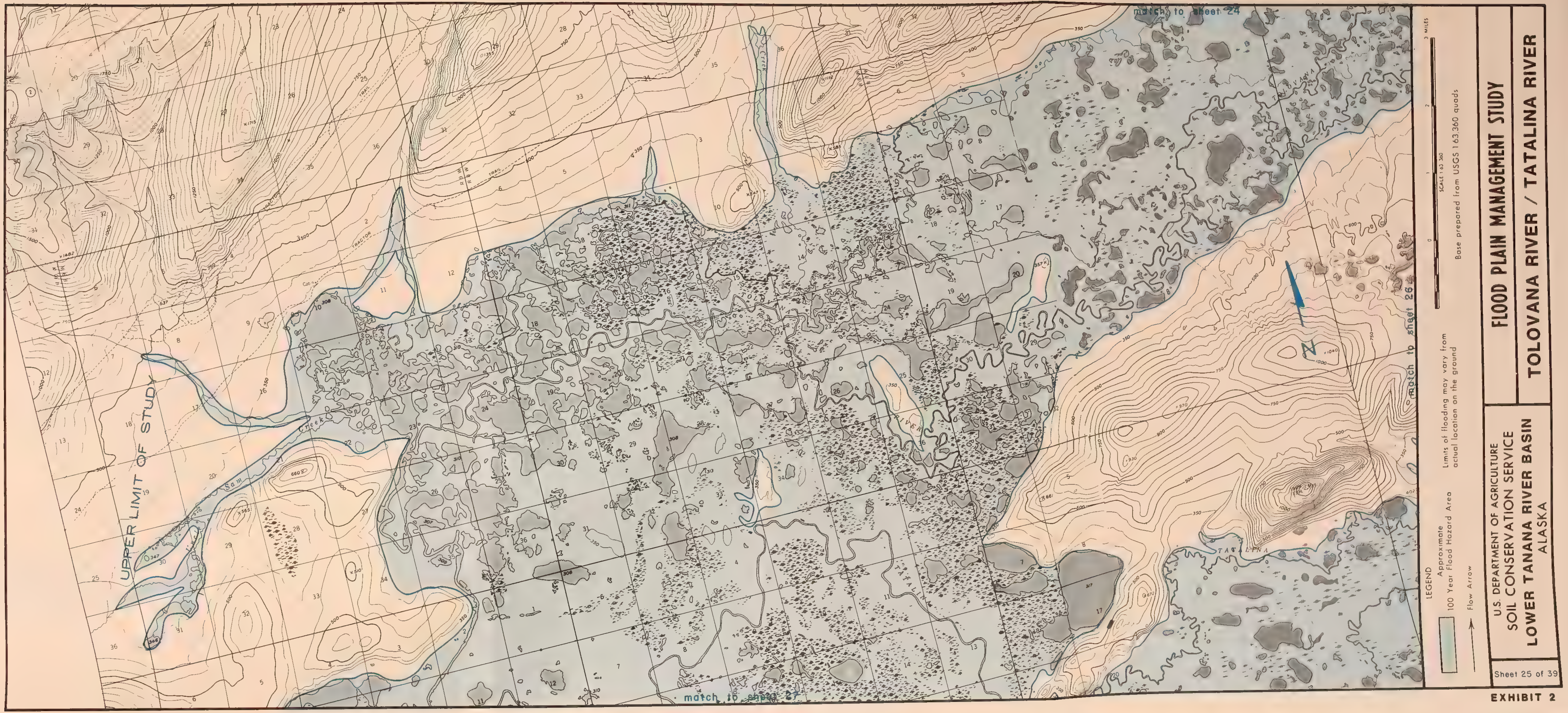
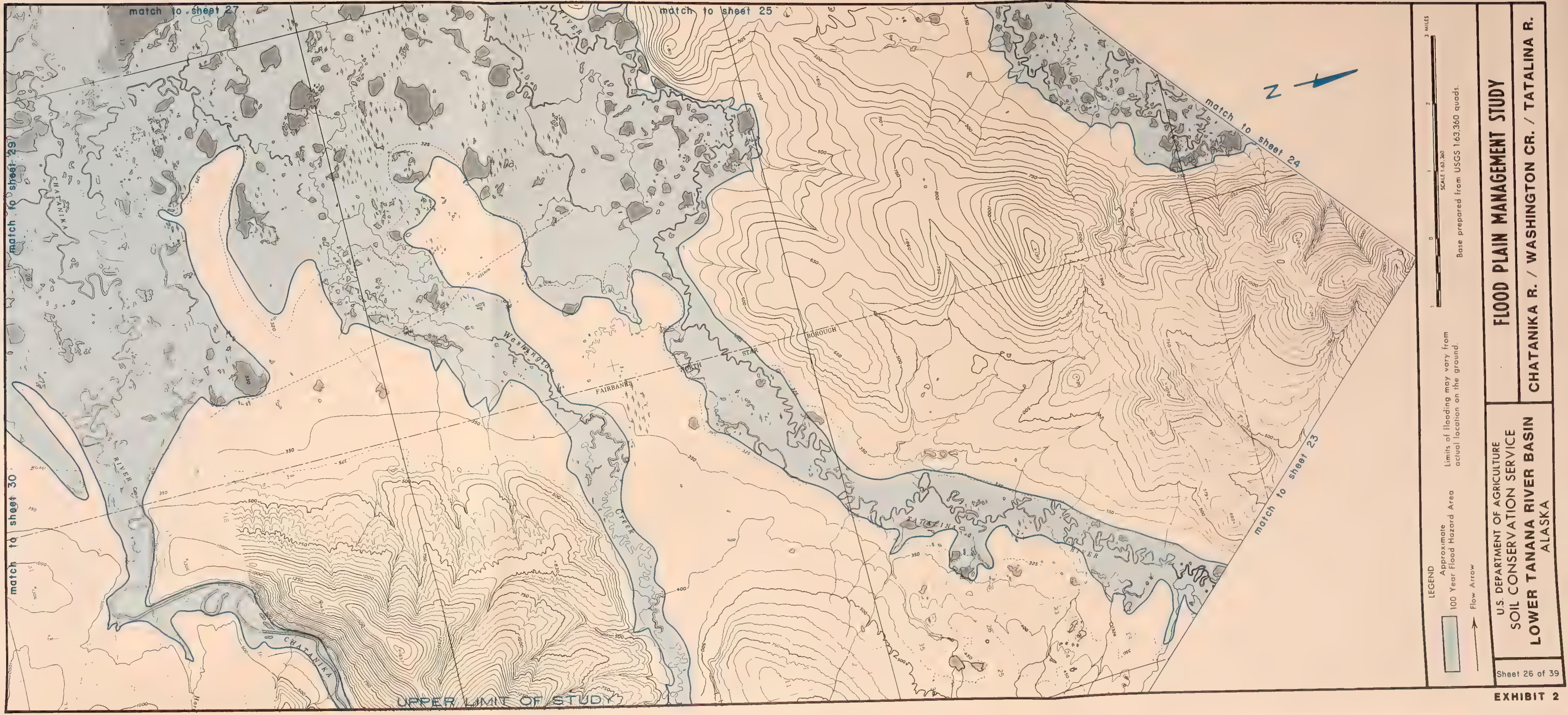

match to sheet 24
match to sheet 26
match to sheet 27
UPPER LIMIT OF STUDY
TOLOVANA
RIVER
TATALINA
LEGEND
Approximate
100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from
actual location on the ground
SCALE 1:63,360
0 1 2 3 MILES
Base prepared from USGS 1:63,360 quads
FLOOD PLAIN MANAGEMENT STUDY
TOLOVANA RIVER / TATALINA RIVER
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 25 of 39

EXHIBIT 2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match to sheet 25
match to sheet 24
match to sheet 23
match to sheet 29
match to sheet 30
CHATANIKA RIVER
Washington Creek
TATALINA RIVER
FAIRBANKS NORTH STAR BOROUGH
UPPER LIMIT OF STUDY
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground.
SCALE 1:63,360
1 0 1 2 3 MILES
Base prepared from USGS 1:63,360 quads.
FLOOD PLAIN MANAGEMENT STUDY
CHATANIKA R. / WASHINGTON CR. / TATALINA R.
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 26 of 39

EXHIBIT 2

LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground.

SCALE 1:63,360

0 1 2 3 MILES

Base prepared from USGS 1:63,360 quads

FLOOD PLAIN MANAGEMENT STUDY

TOLOVANA RIVER / CHATANIKA RIVER

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOWER TANANA RIVER BASIN
ALASKA

Sheet 27 of 39

EXHIBIT 2

LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

SCALE 1:63,360

1 0 1 2 3 MILES

Base prepared from USGS 1:63,360 quads

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

TANANA RIVER / OLD MINTO

Sheet 28 of 39

EXHIBIT 2

LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

1 0 1 2 3 MILES

SCALE 1:63,360

Base prepared from USGS 1:63,360 quads

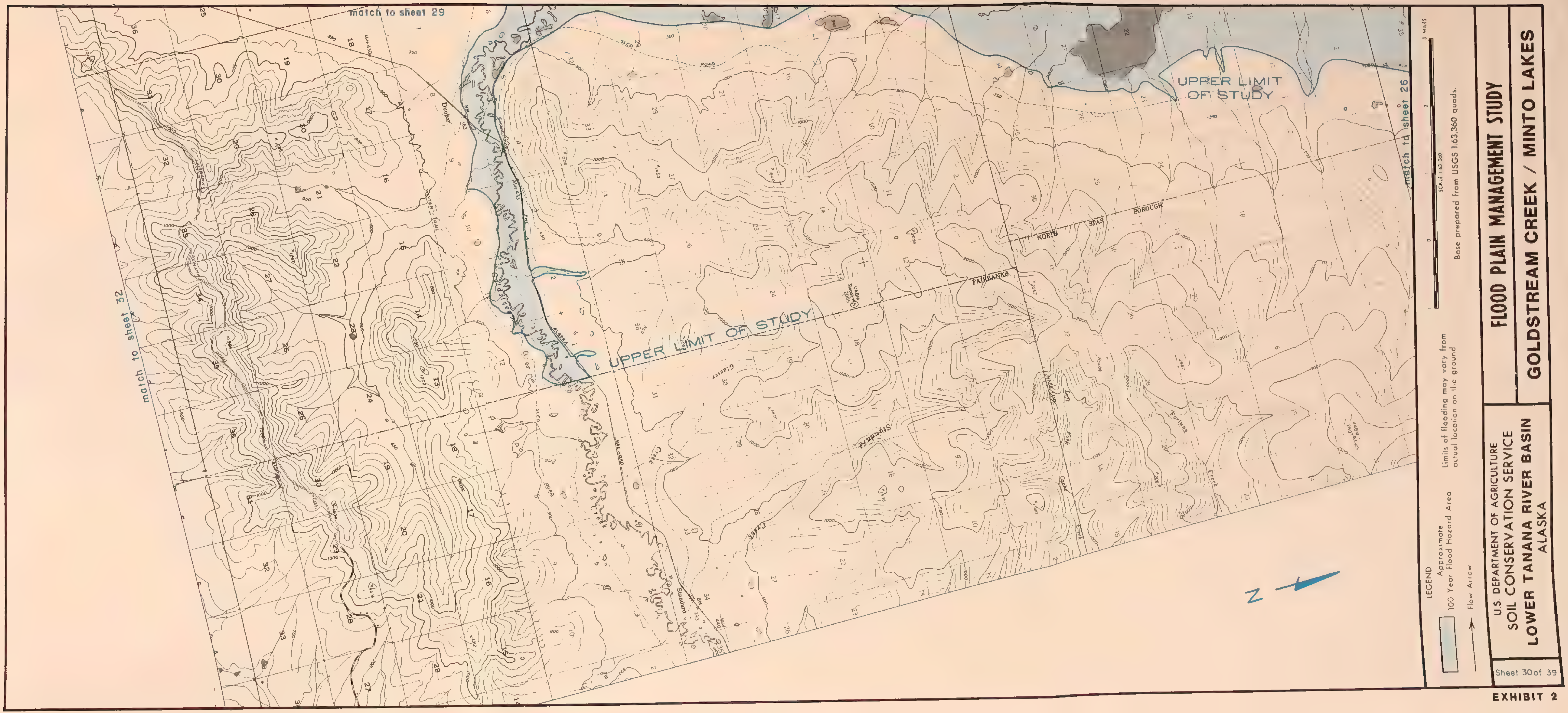
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

TANANA RIVER / MINTO LAKES

Sheet 29 of 39

EXHIBIT 2



match to sheet 29
match to sheet 32
match to sheet 26
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
FAIRBANKS NORTH STAR BOROUGH
RAILROAD
Standard
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
Base prepared from USGS 1:63,360 quads.
N
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
FLOOD PLAIN MANAGEMENT STUDY
GOLDSTREAM CREEK / MINTO LAKES
Sheet 30 of 39
EXHIBIT 2


FLOOD PLAIN MANAGEMENT STUDY
TANANA RIVER / NENANA
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 31 of 39
LEGEND
Approximate
100 Year Flood Hazard Area
Limits of flooding may vary from
actual location on the ground
Flow Arrow
Valley Section
Base prepared from USGS 1:63,360 quads
match to sheet 28
match to sheet 34
match to sheet 33
match to sheet 32
match to sheet 29
NENANA RIVER
West Middle River
East Middle River
TANANA RIVER
Little Nenana River
SEVENTEENMILE SLOUGH
WINTER TRAIL
THE ALASKA RAILROAD
FAIRBANKS
PARKS HWY
Nenana
North Nenana
Nenana Municipal Airport
Creek
Glacier

EXHIBIT 2

LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground.

SCALE 1:63,360 — 0 1 2 3 MILES

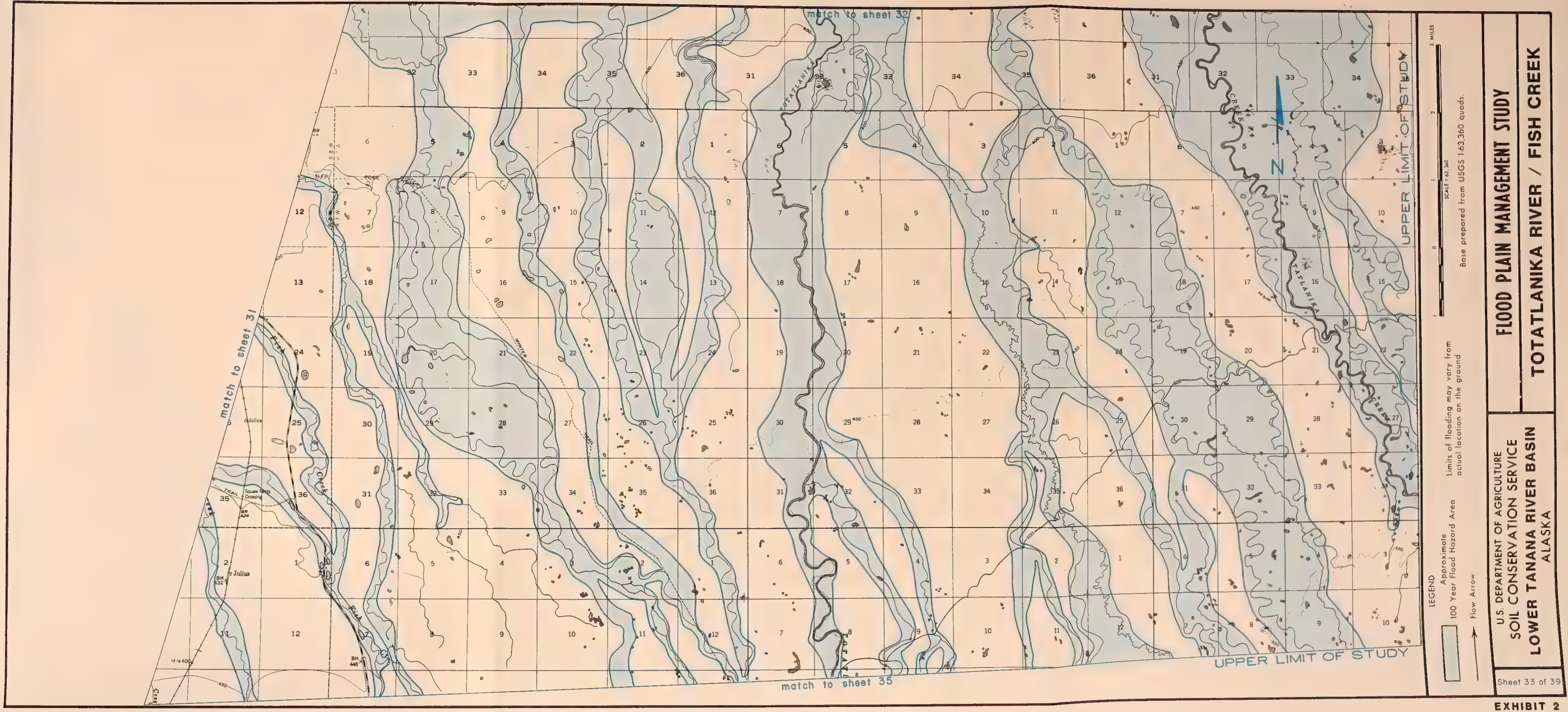
Base prepared from USGS 1:63,360 quads

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

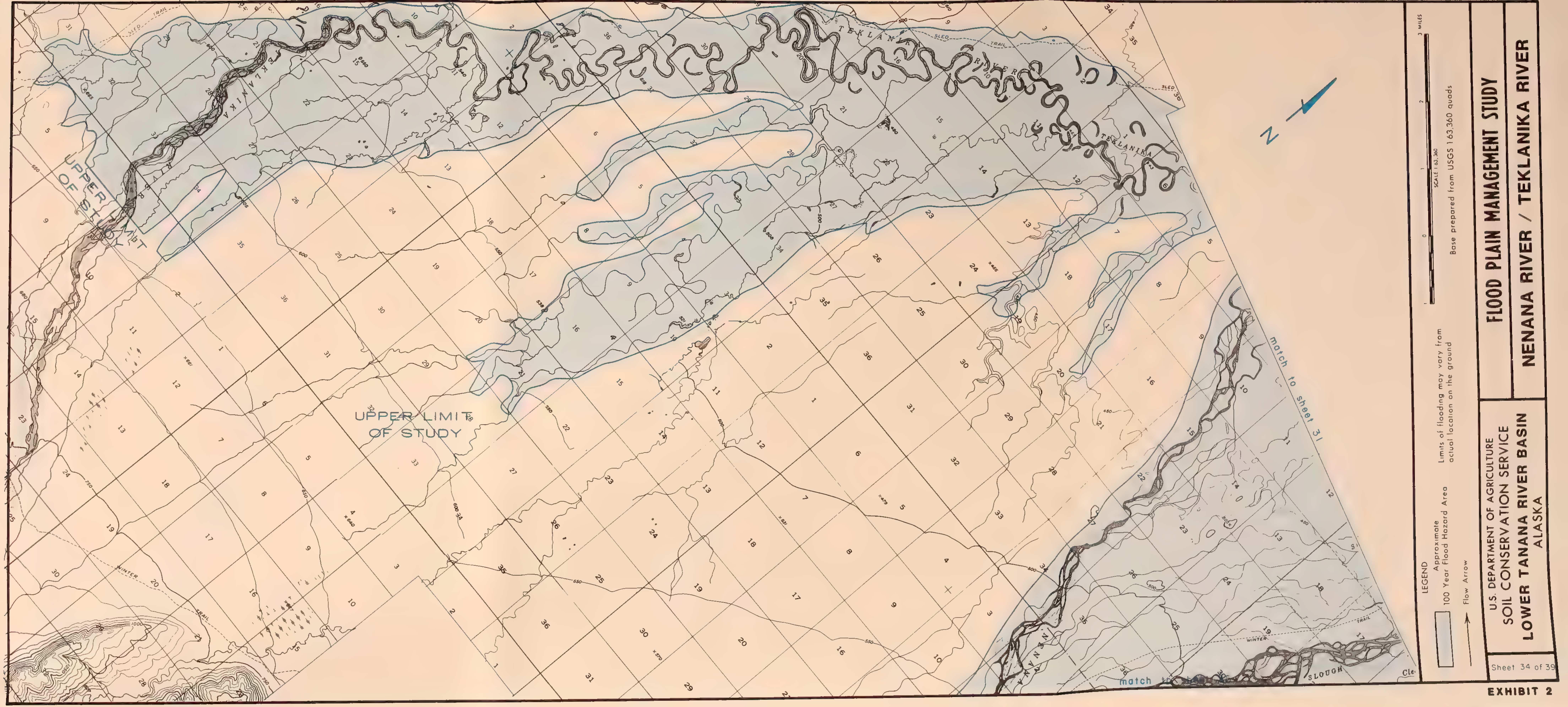
TANANA RIVER

EXHIBIT 2



FLOOD PLAIN MANAGEMENT STUDY
TOTATLANIKA RIVER / FISH CREEK
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 33 of 39
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
Base prepared from USGS 1:63,360 quads.
SCALE 1:63,360
2 MILES
match to sheet 32
match to sheet 31
match to sheet 35
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
TOTATLANIKA
TOTATLANIKA
Fish Creek
Julius
Squaw Flats Crossing
SLED ROAD
WINTER TRAIL
N

EXHIBIT 2



FLOOD PLAIN MANAGEMENT STUDY
NENANA RIVER / TEKLANIKA RIVER
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
Base prepared from USGS 1:63,360 quads
3 MILES
Sheet 34 of 39
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
match to sheet 31
match to sheet
TEKLANIKA
RIVER
TEKLANIKA
NENANA
SLOUGH
SLED TRAIL
WINTER TRAIL
N

EXHIBIT 2

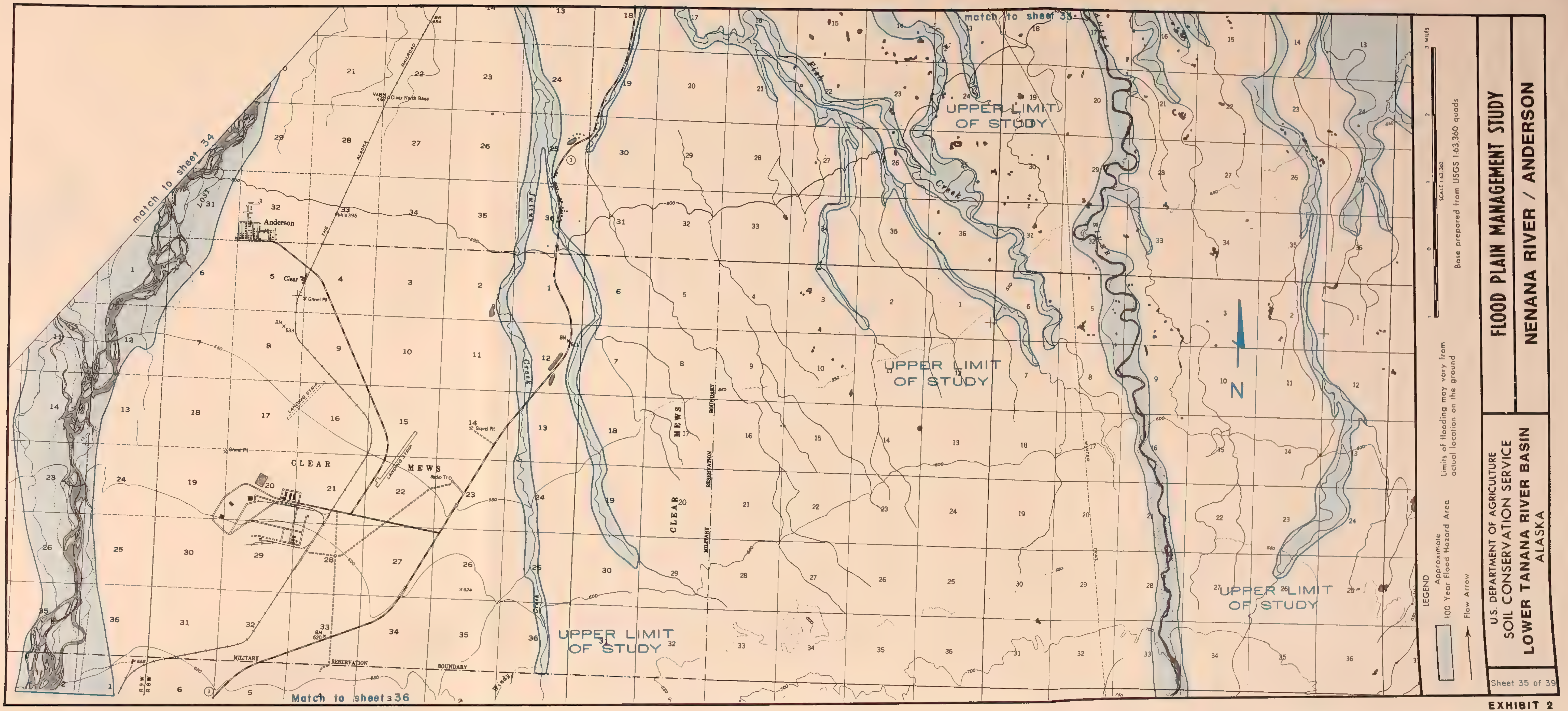
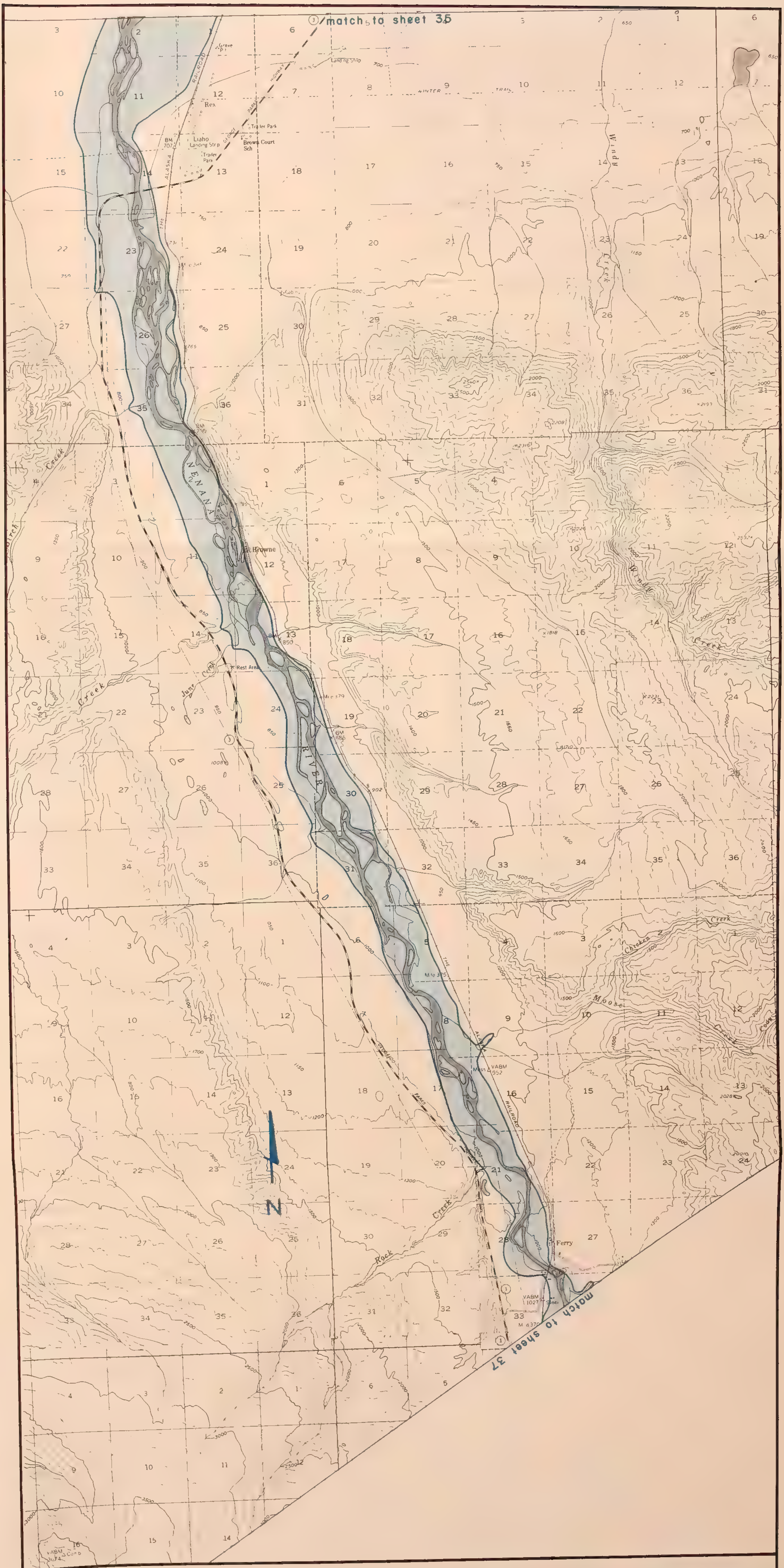

FLOOD PLAIN MANAGEMENT STUDY
NENANA RIVER / ANDERSON
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
Sheet 35 of 39
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
Base prepared from USGS 1:63,360 quads
3 MILES
match to sheet 34
Match to sheet 36
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
Anderson
Clear North Base
Clear
Gravel Pit
LANDING STRIP
CLEAR
MEWS
Radio Tr
MILITARY RESERVATION BOUNDARY
ALASKA RAILROAD
N

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground

SCALE 1:63,360

Base prepared from USGS 1:63,360 quads.

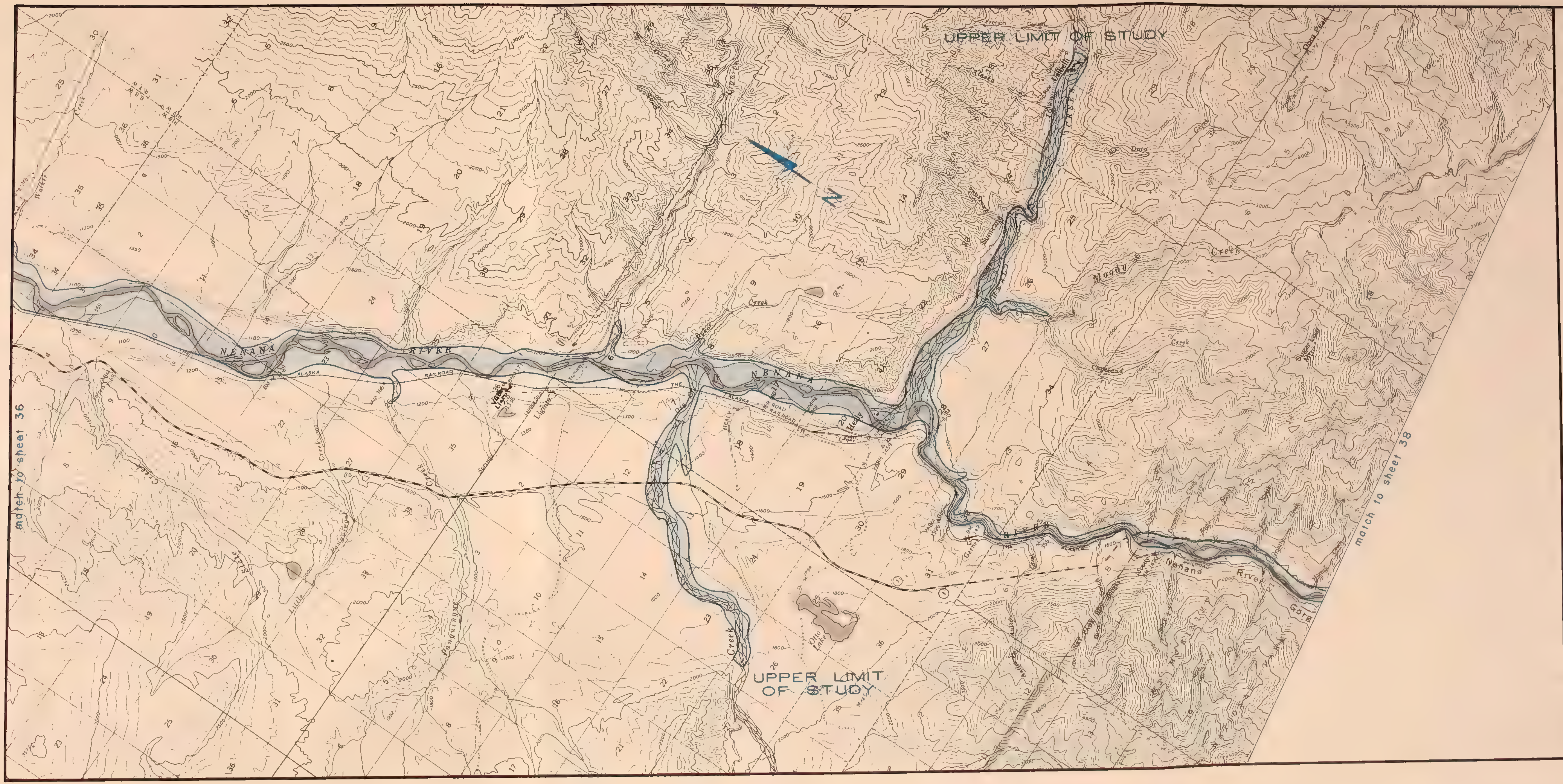
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

NENANA RIVER

Sheet 36 of 39

EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground.

SCALE 1:63,360

0 1 2 3 MILES

Base prepared from USGS 1:63,360 quads.

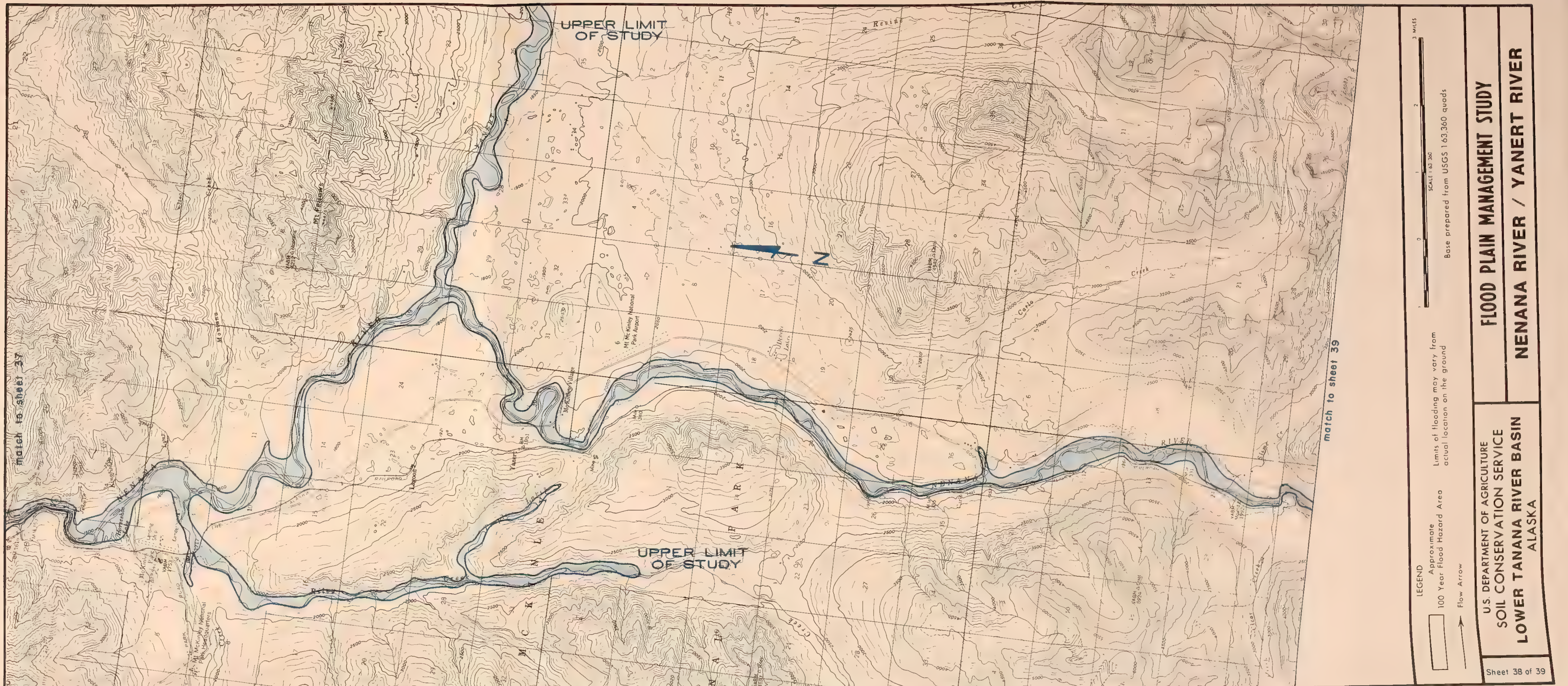
FLOOD PLAIN MANAGEMENT STUDY

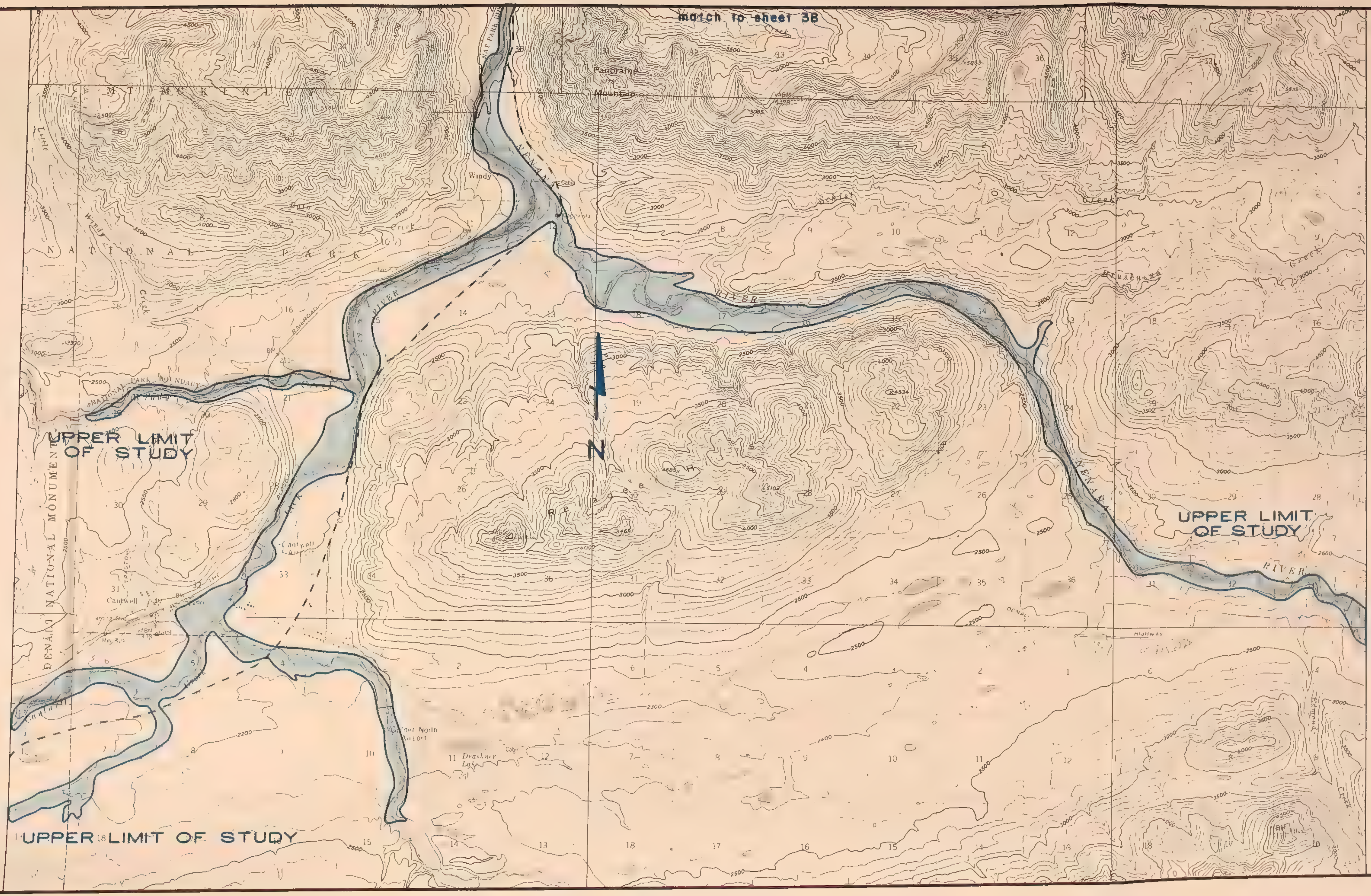
NENANA RIVER / HEALY CREEK

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

Sheet 37 of 39

EXHIBIT 2


UPPER LIMIT OF STUDY
UPPER LIMIT OF STUDY
match to sheet 37
match to sheet 39
N
NENANA RIVER
Mt McKinley Village
Mt McKinley National Park Airport
Mt McKinley National Park Headquarters
McKINLEY PARK
Carlo Creek
Mt Fellows
LEGEND
Approximate 100 Year Flood Hazard Area
Flow Arrow
Limits of flooding may vary from actual location on the ground
SCALE 1:63 360
0 1 2 3 MILES
Base prepared from USGS 1:63,360 quads
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA
FLOOD PLAIN MANAGEMENT STUDY
NENANA RIVER / YANERT RIVER
Sheet 38 of 39
EXHIBIT 2



LEGEND

Approximate 100 Year Flood Hazard Area

Flow Arrow

Limits of flooding may vary from actual location on the ground.

SCALE 1:63,360

0 1 2 3 MILES

Base prepared from USGS 1:63,360 quads

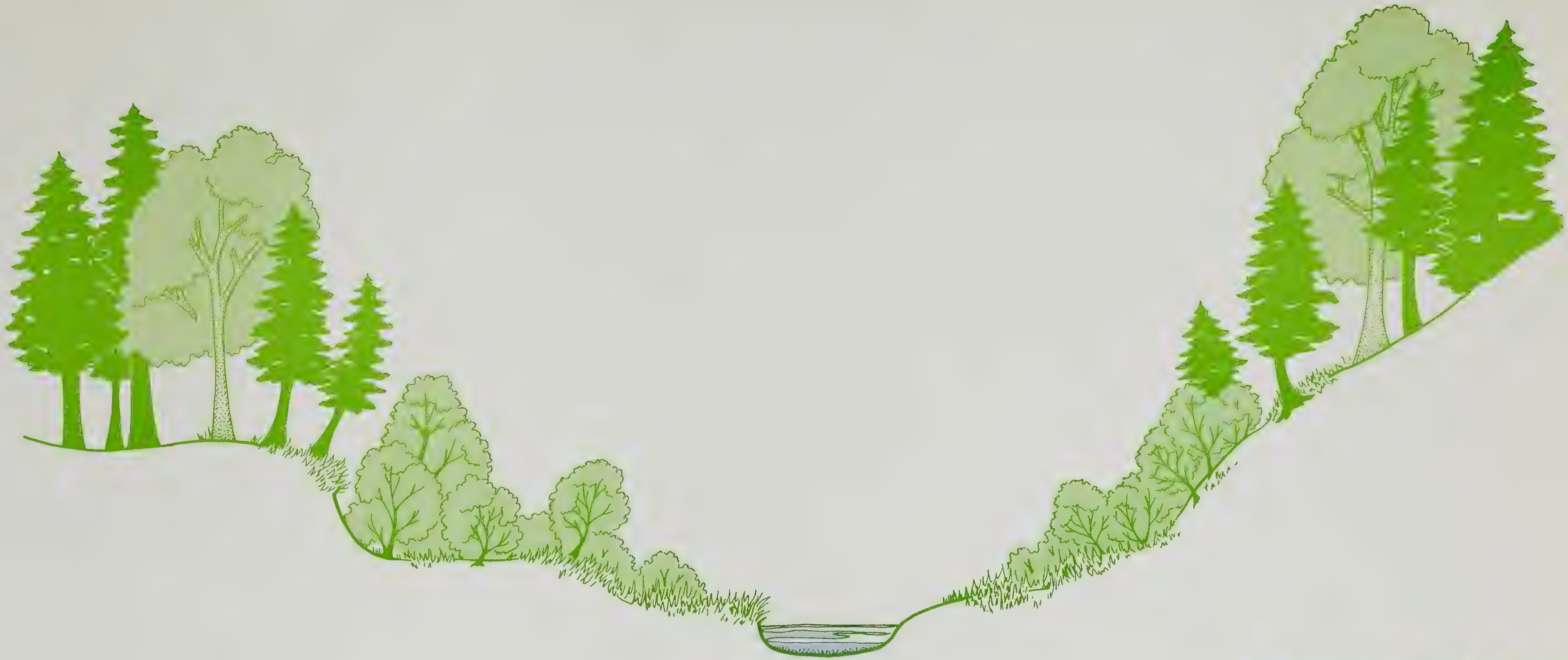
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LOWER TANANA RIVER BASIN
ALASKA

FLOOD PLAIN MANAGEMENT STUDY

NENANA RIVER / JACK RIVER

Sheet 39 of 39

EXHIBIT 2



APPENDIX C

SUMMARY OF BIOLOIGICAL FLOOD PLAIN VALUES IDENTIFIED IN THE LOWER TANANA FLOOD PLAIN MANAGEMENT STUDY AREA

SUMMARY OF BIOLOGICAL FLOOD PLAIN VALUES IDENTIFIED IN THE LOWER TANANA FLOOD PLAIN MANAGEMENT STUDY AREA

ADF&G definitions of ''critical,'' ''prime,'' and ''important'' habitats are as follows (ADF&G, 1983, Tanana Basin Area Plan - Fish and Wildlife Element. ADF&G, Fairbanks):

> **"Prime"** habitats are those capable of supporting maximum densities of one or more species on a long-term basis and are necessary for perpetuation of those populations... Prime habitat may also include **critical** habitat, which is defined as those habitats that because of their unique and valuable qualities are particularly crucial to the perpetuation of one or more species groups of wildlife... **Important** habitats are those ... capable of supporting medium or high densities of one or more species groups for short or long periods of time and important to the perpetuation of those populations... In general, the habitat quality is lower than prime habitat because the plants ... are of lower quality as food or cover, are less abundant, or their spatial arrangement is less advantageous to the species in question.''

SUMMARY OF BIOLOGICAL FLOOD PLAIN VALUES IDENTIFIED IN THE LOWER TANANA FLOOD PLAIN MANAGEMENT STUDY AREA

River or Stream Corridor	Biological Values (see footnotes for definitions of "prime," "critical," and "important" habitats)
Baker Creek	• critical chum salmon spawning habitat, also supports Arctic grayling populations
Bearpaw River wetlands	• critical waterfowl habitats, providing nesting and molting habitats for high concentrations of several species and stopover sites for sandhill crane and other waterfowl (see Tanana River)
lower Bearpaw River	• spawning areas for chum and king salmon • fall black bear salmon feeding areas • prime waterfowl habitat for nesting, molting, and migratory stopovers
Chatanika River	• habitats for resident fish populations, including spawning habitat for large runs of whitefish • migratory route for spawning chum and king salmon
Chitanana River	• prime habitats for resident fish, providing spawning, feeding, and rearing habitats for northern pike, whitefish, burbot, Arctic grayling, and sheefish
lower reaches	• prime moose habitats • important spring bear habitats
Cosna River	• prime habitats for resident fish, providing spawning, feeding, and rearing habitats for northern pike, whitefish, burbot, Arctic grayling, and sheefish
lower reaches	• prime moose habitats • prime furbearer habitats • important spring bear habitats
Fish Lake and Fish Creek*	• prime habitats for resident fish populations, including sheefish (Fish Creek) and whitefish and northern pike (Fish Lake)
Fish Lake wetlands*	• prime habitats for waterfowl, including nesting and molting for diving ducks and stopover sites for waterfowl species using Tanana River migration corridor

Fish Lake area*	• prime moose habitats • prime furbearer habitats
Globe Creek	• supports small sport fishery
Goldstream Creek (at outlet into Minto Flats)	• prime owl habitats
Hutlinana Creek	• critical chum salmon spawning habitats, also supports Arctic grayling
Kantishna River	• critical spawning, rearing, and feeding habitats for chum, coho, and king salmon • prime habitats for resident fish, including rearing and overwintering habitats; supports whitefish, sheefish, northern pike, Arctic grayling, and burbot • prime moose habitats • prime furbearers habitats • prime grizzly habitats • nesting and molting habitats for waterfowl, including Canada goose • important stopover sites for sandhill crane and other bird species following Tanana River corridor
lower Kantishna River (and Kantishna wetlands south of Tanana River)	• contains many ponds and sloughs, these support beaver, mink, muskrat, river otter, and waterfowl, as well as moose calving areas
Minto Flats*	• constitutes largest shallow lake and wetland area in Tanana Basin • prime habitats for resident fish populations, including Arctic grayling, northern pike, whitefish, sheefish, and burbot • migratory routes used by chum and king salmon • prime black bear habitats, particularly supplying emerging vegetation in spring and berries in late summer • prime furbearer habitats • prime and critical moose habitats, providing critical winter feeding areas, as well as calving areas and year-round food and cover

* Not specifically addressed in flood plain study but included here because a) located in study area and b) provides very high biological values.

SUMMARY OF BIOLOGICAL FLOOD PLAIN VALUES (CONTINUED)

	• lakes used by several waterfowl species during all ice-free seasons of year; habitats provided include critical and prime habitats for nesting, feeding, molting, staging, and migratory stopovers; species using Flats include Canada goose, trumpeter swan, tundra (whistling) swan, sandhill crane, common snipe, canvasback and other ducks, and several species of shorebird • in late 1970's contributed over 4% of estimated statewide duck harvest • prime raptor habitats
Nenana River and tributaries lower reaches and northern tributaries, includes: Clear, Fish, Julius, and lower Windy Creeks, Lost and Seventeenmile Sloughs, and Teklanika River (see also values under Teklanika River)	• critical spawning, feeding, and rearing habitats for coho, chum, and/or king salmon, especially spring-fed areas and tributaries; spawning areas have been identified in Seventeenmile and Lost Sloughs, Julius Creek drainage, Clear and Fish Creeks • contribute salmon to downstream commercial, sport, and subsistence fisheries; Clear Creek is release point for salmon reared at ADF&G Clear hatchery • important habitat for resident fish, including Arctic grayling, northern pike, and whitefish; resident fish support sport fishery • prime and important moose habitats, particularly for wintering and calving; road access creates popular moose harvest and viewing areas • critical, prime, and important black bear habitats: critical habitats consist of salmon spawning shallows (e.g., Seventeenmile Slough); prime habitats consist of boggy areas (supplying blueberries, cranberries, etc.), sedge meadows, and lake and pond margins • prime and important grizzly habitats, particularly along salmon spawning streams • prime and important habitats for furbearers, including beaver, otter, mink, muskrat, coyote, fox, wolf, wolverine, lynx, and marten
upper reaches and southern tributaries (Alaska Range and foothills), includes Bear, Birch, Cantwell, Healy, Jack, Lignite, Moody, Panguingue, Little Panguingue, Rock, Slate, and upper Windy Creeks; Yanert Fork and Yanert Fork tributaries	• critical, prime, and/or important salmon habitats; spawning areas so far identified in Panguingue and Little Panguingue Creeks • important habitats for resident fish; grayling populations are known to occur in Birch, Bear, Panguingue, Rock, and Slate Creeks • critical and prime moose habitats, particularly for summering, staging, rutting, and breeding; in some areas (e.g., lower Moody Creek), moose concentrations may reach 7-10 moose per square mile in late fall and early winter; lower Moody Creek provides critical moose staging and breeding habitats, Windy Creek and parts of Yanert drainage provide prime moose habitats • prime and important grizzly habitats; in spring, grizzlies concentrate in valley bottoms where green vegetation first appears; in fall, along salmon spawning streams; Windy Creek is moderately popular grizzly hunting area

	• critical and prime caribou habitats, including winter range and calving areas; critical calving areas for Yanert caribou herd occur around headwaters of Moody and Healy Creeks • important furbearer habitats; wolverine densities are high • prime habitats and nesting sites for great horned owl, goshawk, golden eagle, and American kestrel along Nenana River between Healy Creek and Yanert Fork; Savage River provides important owl habitats
Tanana River	• important migratory pathway for king, chum, and coho salmon • prime spring/summer moose habitat on Tanana Flats; riparian willow stands provide prime winter moose habitats • prime black bear habitats, especially spring and fall feeding areas • prime furbearer habitats • major migration corridor for sandhill crane and other waterfowl species • wetlands and flood plains provide nesting habitats for all waterfowl species common to interior Alaska, including American widgeon, pintail, mallard, green-winged teal, shoveler, canvasback, lesser scaup, common goldeneye, bufflehead, Canada goose, white-fronted goose, trumpeter swan, and sandhill crane • tallest trees in forests along Tanana River and tributaries are critical bald eagle nesting and perching sites, cliffs provide nesting habitats for golden eagle • critical peregrine falcon habitat; known peregrine nesting site about halfway between confluence of Tanana River with Nenana and Yukon Rivers
Tanana Flats (along Tanana River east of confluence with Nenana River)	• prime moose habitats, especially winter, calving, and summer ranges; riparian and wetland areas heavily used by both resident and migratory populations; area moose population is currently moderately high and increasing • prime and important black bear habitats, providing sedges, horsetails, and other green shoots important in spring • important overwintering habitat for small group of several hundred caribou that overwintered in Flats 1981-82 • prime furbearer habitats for wolf, fox, lynx, marten, beaver, mink, otter, muskrat, coyote, and wolverine; supports heavy trapping effort • critical, prime, and important waterfowl habitats, especially important to trumpeter swan (provides critical swan nesting habitats) and diving ducks; importance increases in dry seasons when other areas with less stable water levels are unsuitable for nesting • prime raptor habitats: peregrine falcon and bald eagle nest on cliffs along the Tanana River and hunt over the Flats

SUMMARY OF BIOLOGICAL FLOOD PLAIN VALUES (CONTINUED)

lower Tatalina River	• supports small sport fishery • prime furbearer habitats • prime black bear habitats • prime moose habitats
Tatlanika and Totatlanika Rivers lower reaches	• important black bear habitats; low areas along watercourses provide important spring food as they "green up" • prime moose habitats for wintering and calving • prime furbearer habitats • important waterfowl habitats, particularly in dry seasons (see Tanana Flats); trumpeter swan nest east of the Totatlanika River
upper reaches	• critical and prime moose fall habitats • prime grizzly habitats, particularly in spring when riparian corridors "green up" before other vegetation is available; Totatlanika River corridor heavily hunted for grizzly bear • critical and prime caribou migration and winter habitats • furbearer habitats include prime habitats for wolf and wolverine, important habitats for lynx and fox
Teklanika River (see also Nenana River: lower reaches and northern tributaries)	• information on fish resources limited, but resident fish common to the Tanana River drainage are likely to occur in the Teklanika system; clear-water tributaries may be important habitat for resident fish • important moose habitat, particularly riparian willow stands, which provide winter food and cover • important black bear habitats; drainage currently supports relatively high black bear populations; riparian areas, lowlands, berry patches, and salmon migration and spawning streams are particularly important • prime and important grizzly bear habitats; most important are salmon migration and spawning areas • prime and important furbearer habitats, including prime lynx breeding habitat and possibly critical lynx habitats; relative to populations in other areas of the Tanana Basin, lynx are abundant; and coyote, marten, mink, red fox, wolf, and wolverine are moderately abundant; winter trapping intensity is moderate to heavy; lynx harvests are among highest in State

Toklat River	• critical salmon spawning area, supporting largest known population of fall-run chum salmon in Alaska (during 1979 foot survey, over 161,000 chum salmon were counted); provides ideal spawning, egg incubation, and salmon fry rearing conditions, particularly in area of Toklat River Springs • prime moose habitats • prime furbearer habitats • prime grizzly habitats
Toklat River Springs (confluence of Toklat and Sushana Rivers)	• critical salmon spawning area (see above) • critical waterfowl overwintering area, supporting 500-600 overwintering mallards (believed to be northernmost sizable overwintering concentration in North America) • critical furbearer habitats • critical grizzly habitat: fall chum provide an important food source for a significant portion of the Mt. McKinley grizzly bear population • prime raptor habitats; open water areas with late salmon runs are critical bald eagle habitat during fall and early winter
Tolovana River	• prime habitats for resident fish, particularly whitefish and Arctic grayling in the upper reaches and sheefish, northern pike, burbot, whitefish, and grayling in the lower reaches • prime furbearer habitat • critical and prime moose habitats • prime black bear habitat
lower Tolovana River	• prime habitats for king and chum salmon, particularly in Minto Flats area • provides band of prime waterfowl habitat
headwaters Tolovana River	• prime caribou habitat, providing part of the winter range used by the White Mountain caribou herd (numbering 300-400); alpine riparian draws supporting dwarf birch and willows are particularly important winter habitat (along with windswept ridges)
Washington Creek	• supports small sport fishery
Wood River lower reaches	• important black bear habitats; low areas along watercourses generally "green up" early in spring and are important for black bears emerging from winter dens; currently supports moderately high black bear densities • prime moose habitats, particularly for wintering and calving • prime furbearer habitats

SUMMARY OF BIOLOGICAL FLOOD PLAIN VALUES (CONTINUED)

	• important waterfowl habitats, particularly for trumpeter swan and diving ducks; importance increases in dry nesting seasons (see Tanana Flats) • prime raven nesting habitats
upper reaches	• prime moose habitats, especially for fall rutting and breeding • prime grizzly habitats, particularly in spring when riparian corridors "green up" • critical and prime caribou habitats: critical calving areas for Yanert caribou herd (currently 700-900 herd) • furbearer habitats include prime habitat for wolf and wolverine, important habitats for lynx and fox
Zitziana River	• prime habitats for resident fish, providing spawning, feeding, and rearing habitats for northern pike, whitefish, burbot, Arctic grayling, and sheefish
lower portions	• prime moose habitats • prime furbearer habitats • important spring bear habitats